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ELECTRICAL WORLD AND ENGINEER.

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THE AMERICAN-PACIFIC CABLE.

President Roosevelt's message to Congress this week contains one passage of particular importance to electrical engineers, namely, that in which he describes the course of events with regard to the terms and conditions made with the Commercial Pacific Cable Company, under which "an all-American line between our Pacific Coast and the Chinese Empire, by way of Honolulu, and the Philippine Islands, is thus provided for." This is in reality one of the most important items in the message, and the President will soon have the great satisfaction of using that cable to exchange congratulations with all the rulers of the East as well as with our own dependencies. We could have wished that the cable had been more strictly speaking "all-American," and had been made in this country, but now the main thing is that it will be available to aid and stimulate intercourse with the Pacific. What that may mean commercially to us is intimated by the remarkable article in our pages on the Sydney Tramways, where practically the whole equipment is of American origin. What has been done there can be done elsewhere, especially with the aid of reciprocity treaties, for as the young Prince of Siam suggested when here, it takes two to an agreement and to be friendly, and his people like the rest are ready to meet us half way. There is so much we need from the East and so much we can send there, the Pacific cable has become a necessity to commerce and will, we believe, be an aid to international friendship.

POWER FOR RAILROADS.

We are very much interested in an article by Mr. Cornelius Vanderbilt on electricity as a motive power for trunk railroads, appearing in the *North American Review* for December. It is an extremely creditable production and stamps the young engineer as a thinker of no small ability. It is a careful study of the situation, and reaches the conclusion that while it is possible from the engineering standpoint to adopt electricity, the change is not possible regarded from the financial point of view. Mr. Vanderbilt dismisses at once all considerations as to the convenience and comfort of the passenger, for while admitting that better facilities often pay for themselves, he urges that all that a railroad manager has to look at is freight business. Let us quote him: "We know from experience that, in passenger service, increased convenience and facilities in many cases more than compensate for increased cost of transportation. This convenience, as we may term it for want of a better word, includes general convenience to passengers, speed, number and frequency of trains, and is the all-important point in passenger traffic. Combining this with the fact that, after a certain density of traffic is realized, the fuel cost may be reduced, we have the reason for the success of the trolley system and for the adoption of electricity as motive power on certain metropolitan and suburban roads. In passenger traffic, the position of the road should determine, in the main, whether electricity is to be adopted, due consideration being given to the possibility of increasing the density of traffic by increasing the convenience, and a final judgment being rendered in its favor when it is seen that the density induced by this convenience will warrant the greater first cost and produce a larger net return (after deducting interest and cost of operation of the additional machinery) than will be produced if steam power is used. This net return may be procured either by a decreased fuel cost, if the density of traffic is sufficient, or by increased rates should the convenience be so increased that the passengers are willing to pay for it."

We understand Mr. Vanderbilt to concede by this the fact that electricity is a good thing for passenger traffic; but he argues that, as to freight it is out of the question; and freight, he contends, is the determining factor. Moreover, the freight traffic is not dense enough, and "it may be said that there are at present no roads in the United States deriving two-thirds of their total revenue from the transportation of freight, which is a fair proportion for a trunk line, on which this condition is found," viz., with traffic density enough for the change.

It is to be noted that Mr. Vanderbilt assumes and talks about "increased cost of transportation" as associated with the change to electricity; but we are not aware of any facts whatever to justify this idea or inference. It is certainly not derivable from street railway results, nor even from the still limited but profitable changes on the Manhattan; nor from other elevated roads. It will be observed that Mr. Vanderbilt discusses "trunk roads," but we should have liked a closer definition of the phrase, for it is possible that here a confusion may exist in Mr. Vanderbilt's mind. Perhaps it would be fairer to ask, what is the density of traffic at which a trunk road ceases to be a trunk, or whether a trunk is such because of length, or whether it will cease to be a trunk when it is cut up into sections with electricity fed into them. In this change that Mr. Vanderbilt in spite of himself allows to be "in the air," and which he discusses with an almost-thou-persuadest-me attitude, it seems to us that some of the English roads are likely to be leaders, for they are seriously taking up the subject and have the exact conditions of density which we gather from Mr. Vanderbilt's article to be required before steam is abandoned. We shall not be surprised to see England or Germany lead us in this respect, just as the United States has undoubtedly led in street railway work; although we are inclined to claim some of the interurban electric systems as well within Mr. Vanderbilt's apparent "trunk road" category, for length and other conditions.

One other point strikes us in an article we may return to for other discussion, and that is Mr. Vanderbilt's apparent assumption that all is well in the trunk road handling of freight by steam locomotive methods. Now, we can easily conceive methods of freight handling with electric power by which freight would not get so horribly congested as it did recently at Pittsburg, but which would encourage the sending of many a ton of perishable freight that the steam roads do not get. Against steam freight locomotives of but one or two sizes at best, allowing very little variation in size of train hauled, if efficiency is considered, it does seem that the undeniable flexibility of electric systems would enable many new and better things to be done that have not entered into the philosophy of men bred under the more rigid old steam regime.

ROUND THE WORLD BY WIRELESS.

A recent interview with Mr. Marconi brings forth the announcement that an extensive land campaign is in contemplation. The inventor states that as soon as the success of the present Table Head station is assured, land stations throughout Canada will be erected and also in United States territory a belt of stations joining the Atlantic and the Pacific. In the other hemisphere stations of the first magnitude in Italy and at Cape Town are in contemplation, to be followed by others eventually perhaps girdling the earth. It is an interesting programme, and if carried out will be a worthy pioneer in the great scientific advances of the twentieth century. The plan for future work is scarcely less interesting, however, than some of the more general statements here credited to the brilliant Italian. He is definitely quoted as saying that he does not think his system "will be a serious rival to either ocean or land telegraphy, but will eventually become an auxiliary to it." If this published avowal is fully authentic, as it must be assumed to be in the absence of official contradiction, Marconi himself takes a far more conservative view of the situation than some of his followers. It would look as if syntonic working, obviously a prime necessity if an extensive commercial system is to be evolved, had encountered serious limitations. We have several times dwelt on this phase of the matter, which has looked somewhat dubious from the very start, and it would be small wonder if experimentation had taught the difficulties of the situation. Even without it there is surely a great commercial future for wireless working merely along the seaboard, provided it can be made to work with complete reliability over a bare hundred miles or so. Up to the present there seems to be grave doubt whether this limit can be reached in working every day and all day. In the wireless service on the transatlantic steamers there has been beautiful success in picking up passing neighbors at long range, but there have also been lugubrious failures in reaching the land stations at very moderate distances.

It is perhaps too much to expect a comparatively new apparatus to settle down at once to steady work, and the broadest charity should be extended to cover occasional failures, but the cause of such failures is nevertheless a very important matter. If chargeable to the apparatus it is one thing, if inherent in the nature of the transmission it is quite another. We trust that ere long full data on this phase of the subject will have been accumulated. Apropos, Mr. Marconi is quoted as confirming the report that messages from Poldhu were actually received on board the *Carlo Alberto* in Sydney Harbor, but declining to give out the particulars. It is, of course, his privilege to keep such details to himself, but we greatly regret that he could not see his way clear to speak out. The public is very much interested in knowing whether the news from Cornwall consisted of lengthy and coherent messages, or of repetitions of the famous Morse *S*, or perchance *E* or *P*. It is certainly no mean achievement to have received any signals at all over such a distance, but the practical value of the work hinges on getting through actual messages with some approximation to certainty. We might suggest in this connection that it is by no means certain that ordinary Morse would form the best alphabet for long-distance wireless work. One deals in such case with conditions widely different from those encountered in ordinary telegraphy and our time-honored code may break down where another would score a signal success.

THE GIRDLE AROUND THE EARTH.

At last, after more than fifty years of gradual extension, the telegraphic girdle around the globe has been completed by the laying of the Pacific cable from Vancouver to Australia. This includes the Vancouver-Fanning Island section, which is the longest in the world, being 3,458 nautical or very nearly 4,000 statute miles in length. This gives England three alternative telegraphic routes to Australia, namely, the new "all-British" trans-Pacific route, westwards, the South African route, also "all-British," and the eastern route, via India. Owing to the great length of the Vancouver-Fanning cable, its conductor has been made extra heavy, 600 pounds per knot, or with about 2 ohms per nautical mile. The total weight of copper in this section must be over one thousand short tons. The average depth of the deep-sea cable appears to be about 2,700 fathoms

or a little over three statute miles. Structurally, the core is interesting, owing to the use of strips in the conducting strand. That is to say, there is one central large copper wire, overlaid by four flat strips applied spirally. This forms a more compact strand for the same mass and conductance than when all the components are cylindrical. Twelve different types of cable enter into the complete route across the Pacific. One of the shore ends is very heavy, and weighs 21 tons to the nautical mile. The division of the cost of this cable is remarkable. Canada and Great Britain each assumes about 28 per cent., British Columbia 11 per cent., and the remaining 33 per cent. is taken by the Australian colonies. British North America consequently pays nearly 40 per cent. of the total cost.

THE BOB-TAILED CURRICULUM.

We have already expressed ourselves pretty fully on the subject of collegiate education, so far at least as engineering students, but a recent pronunciamento from President Butler reminds us that there is still something left to be said. That distinguished educator is quoted as saying in effect, that he favors the two-year college course because it is better for the student to dawdle only two years instead of the canonical four. We earnestly hope that he will take steps in our great metropolitan university to avert dawdling even for so short a term as two years. Perhaps the same cogent line of reasoning may adequately explain the grave doubts which have been expressed by noted business men as to the usefulness of any college course at all. The fact is that the weakest point in our whole modern educational system is a certain apparent incapacity to prevent dawdling. When the cultured graduate of the kindergarten, the juvenile art school, the infantile conservatory of music and three or four prenatal laboratories comes up to the college, he is very apt to interrogate Nature as to the easiest way of sliding through. The whole field of classified knowledge and ignorance is open to his choice in the elective system, and he would reflect discredit on his previous training if it should give him no clue to the smooth and easy path. Now to our mind the first duty of the higher institution of learning should be to take this victim of slipshod soul culture by the nose and lead him firmly up to the strenuous life. It is not so much what he learns, as how he learns, that determines his future capacity for serious work. And according to our observation the average college needs considerably more than two years merely to instill the fundamental principles of mental activity. And from that point education begins.

LONG-DISTANCE WIRELESS TELEGRAPHY.

In a recent number of the London *Electrician*, Lieutenant Solari, of the Italian Navy, has published a very interesting account and journal of wireless telegraphic signalling between the high-pressure sending station at Poldhu, Cornwall, and the Italian cruiser *Carlo Alberto* as a moving receiving station, during the period June to September, 1902. A map printed with the article indicates that on her journey from Kronstadt in the Baltic to Spezia in the Mediterranean the *Carlo Alberto* was more or less in communication with Poldhu. That is to say, messages transmitted out from Poldhu were received by the *Carlo Alberto* at various points all along the route. The maximum distance of transmission was nearly 1,400 miles across England, and also across the Scandinavian mountains. This is certainly a brilliant achievement, and as a *tour de force*, Mr. Marconi may well be proud of it. It is to be hoped that eventually such a programme may be regularly scheduled for the benefit of the ordinary passenger steamer. But at the present early stage of wireless telegraphy development, the event seems only to have been rendered possible by its rarity. The signals emitted from Poldhu must have stirred up the circumambient ether for many a long mile from Cornwall in every direction, to the detriment of efforts that may at such moments have been pending to establish wireless communication on a humbler scale and within a narrower compass.

The *Carlo Alberto* was rigged for the work by the addition of top-gallant masts, and between these masts she supported an imposing array or grid of fifty vertical wires descending nearly to the deck, and resembling a gigantic lyre. Poldhu talked to this floating lyre by electrifying a tall cage of wire with impulsively generated pressures of something like 150 kilovolts, judging from the sparking distance mentioned. Lieutenant Solari several times alludes to the observation first published by Marconi, that during daylight hours the long-distance signals were much weaker than during darkness hours. It seems, in fact, that the best long-distance wireless telegraphy is carried on, if not in the light of the moon, at least in the dark of the sun. This is a curious antithesis to the ordinary method of flag-signalling at sea, which, of course, requires daylight.

Two weeks after the Solari report was printed in the *Electrician* an article appeared by Mr. Maskelyne commenting upon the matter. It seems that Mr. Maskelyne was engaged about the same time in carrying on some independent wireless telegraphic operations at Porthcurnow, in Cornwall, 18 miles away from Poldhu, and his apparatus was inundated with the energy emitted from the latter station. He seems to have kept an automatically registered voluminous record of the outpourings of Poldhu's soul. It would seem, in fact, that at least on one occasion a large audience in the community of Porthcurnow was regaled with a message addressed to the *Carlo Alberto* then near Cagliari. This message was automatically repeated from the wireless receiving antenna on the hill above Porthcurnow to the station in the valley, over an ordinary telegraph circuit. Porthcurnow is an important submarine telegraph station containing a number of trained operators. It is intimated that this message was pumped out into space many times during the succeeding 72 hours; but from Solari's journal it does not seem to have been picked up by his ship until near the end of that period, when, however, it was duly registered, and correctly recorded. Poldhu sometimes talked to the mighty deep in English and sometimes in Italian. So closely did Porthcurnow follow the remarks of her neighbor Poldhu, that on occasion Mr. Maskelyne seems to have been called at 2 A. M. because Poldhu was talking "rubbish." Considering the earliness of the hour this might have been considered excusable in Poldhu. But Mr. Maskelyne forthwith trudged to his wireless cable house on the cliff, to see what the gibberish of Poldhu might mean. It appears that by submitting the received impulses to electro-magnetic analysis he resolved Poldhu's jargon into two coincident emissions. One was an important message addressed to the wandering *Carlo Alberto* on the wide, wide sea across Europe, while the other was a separately emitted set of dots, or impulses, thrown in, like a running bass, to muddle the ether, for the benefit of those in the neighborhood who might have antennae to hear. It also seems that Mr. Maskelyne secured records of both the real message in alt., and of the "running bass" of dots.

Mr. Maskelyne concludes with a pathetic appeal to Mr. Marconi to tune his Poldhu station in some manner that the working thereof shall cease to vex Porthcurnow. The cry here is not for wireless messages, but for their obliteration. Porthcurnow seems to regard Poldhu as a "thunder factory." It has not yet transpired in what light Poldhu regards Porthcurnow. In telephony we have passed through a stormy period as to who should electrically possess the earth. It would now seem that we approach a stormy period in wireless telegraphy as to who shall own the heavens.

Independent Telephone Meeting at Chicago.

As already announced in these columns, the second convention of the Interstate Independent Telephone Association will be held in Chicago on December 9th, 10th and 11th, at the Auditorium Hotel, where space will be provided for exhibits. The general and entertainment committee in charge of affairs is composed of James Wolff, C. W. Farr, H. B. McMeal, W. E. Doolittle, S. A. Dinsmore, F. B. Patten and J. J. Nate.

The provisional programme is as follows:

Tuesday morning, December 9th, Executive Committee will receive visitors at the headquarters of the secretary, after which an inspection of the manufacturers' exhibits will follow. An address of welcome will be delivered at two o'clock in the afternoon by H. S. Taylor, prosecuting attorney, Chicago. The response will be given by President H. C. Raney, of Fairfield, Iowa. This will be followed by the reports of the various committees and the selection of the nominating committee by the States to report on call of the president.

Wednesday morning: "Measured Service," George N. Bandy, Perry, Iowa; "Sliding Scale Rates for Exchanges," Dr. H. S. Herr, Ottumwa, Iowa; "Toll Rates," H. H. Robinson, Cleveland, Ohio. After the reading of these papers on rates and accompanying discussion, time will be taken for a review of the "Restrictions by Municipal Authority." It is expected that synopses of the law in Ohio, Iowa, Wisconsin, Minnesota, Michigan, Indiana, Illinois, Missouri and Kentucky will be given.

Wednesday afternoon: "Settlement of Toll Business between Connecting Companies," A. L. Hutchison, Weyauwega, Wis.; "Enforcement of Message Time Limit," H. E. Ralston, Maitland, Mo.

Thursday morning: "Independent Telephone Securities as an Investment," by Col. J. D. Powers, of Louisville, Ky., and J. H. Layne, of Carthage, Mo., the former treating the subject from a banker's point of view, and the latter from that of the small investor.

Thursday afternoon: "The Berliner Patent, Bell's Claims of Infringement and Litigation now Pending," by J. J. Nate, Chicago, and "Suggested Methods for Improving Long-Distance Telephony," by Senator C. E. Hull, Salem, Ill.

A banquet is proposed for the night of either the 10th or the 11th.

Engine Builders' Association.

The Engine Builders' Association of the United States met at Sherry's on Monday afternoon, December 1, with Mr. W. M. Taylor, of Indianapolis, in the chair. Four papers were read as follows: "Superheated Steam," by Ernest H. Foster, of New York; "High-Pressure Steam Piping," by William Andrews, of New York; "The Early History of the Corliss Engine," by Geo. R. Phillips, of Greene, R. I.; "The History of the High-Speed Engine," by Prof. John E. Sweet, of Syracuse, N. Y.

Mr. Foster in his paper gave in detail the advantages to be derived from the use of superheated steam, and pointed out the precautions to be observed in designing engines and piping systems where superheated steam is used. The use of superheat has been rendered possible by the introduction of mineral oil and graphite lubricants and the evolution of efficient superheating apparatus. At present the superheater may be depended upon as safely as a boiler or engine, or any other part of a steam plant. No difficulty is met now in dealing with the moderate superheat, that is to say, from 100 to 150 degrees. If the engine is compound, the steam having lost its superheat at the exhaust point of the high-pressure cylinder, is resuperheated about 100 degrees in a reheater between the high and low-pressure cylinders, and again loses its superheat while expanding in the low-pressure cylinder, arriving at the point of exhaust with the steam at the temperature of saturation. To employ high degrees of superheating, it is at present considered important to use poppet valves on the high-pressure cylinder at least. Mr. Foster considers that in the present state of the art, it would be best for American engine builders to confine themselves to the use of moderate superheating. A case is cited where the gain in economy with a 1,000-hp engine with the use of high superheat was 39 per cent. Superheating will also enable the steam pipes and ports to be reduced in area. With superheating the use of the steam jacket is obviated. No difficulty is experienced in lubrication if a reasonably good grade of mineral oil is used. Superheated steam is destined to play an important part in the adoption of the steam turbine.

Mr. Andrews gave a sketch of the evolution of steam piping during the past quarter of a century. The present wrought steel piping was introduced about 1892, and has almost superseded all other kinds of piping. With the advent of high-pressure superheated steam the size of pipes has been much reduced. A radical departure consists in running pipes from the header two sizes smaller than that called for by engine builders. These pipes before reaching the engine are carried into a wrought iron or steel receiver placed near the engine, which acts as a separator and has a cubic capacity about three times that of the high-pressure cylinder. The pipe from the receiver to the cylinder is of the full size called for by engine builders.

Prof. Sweet gave his recollections of the early days of the high-speed engine industry, beginning about 1862 with the Allen engine. A considerable portion of the paper is devoted to this engine and its commercial development under Mr. Charles T. Porter. Reference was made to a number of other automatic engines, including the Buckeye, Payne, "Straightline," Armington & Sims, Westinghouse and Ball.

The paper by Mr. Phillips consisted of a biographical sketch of George H. Corliss, which included an account of his various business connections and his litigation with Sickles. The more important early Corliss engine plants were described in detail, and a chronological account given of the improvements made by Corliss from time to time.

On Tuesday afternoon at the business meeting of the association the officers for the ensuing year were elected. Mr. W. M. Taylor was re-elected president, Mr. C. A. Gates vice-president, Mr. C. S. Bonsall treasurer, and Mr. F. P. Ide secretary. On Tuesday evening a banquet was served at Sherry's, which was well attended and thoroughly enjoyed by all present.

Drawbacks of the Country Telephone.

The introduction of the telephone into farming and rural districts has been a great boon to all concerned, but some of its drawbacks are hinted at in a recent article in the *Detroit Free Press* as follows:

"City people whose neighbors use their telephones think they know all about trouble," said a ruddy-faced amateur farmer, "but I'll compare notes with them any day. If you are not obliging to your neighbors in the country you had better move back to town; so this is what we go through with in order to be obliging. We have the only telephone in our vicinity, and my wife and I ought to draw salaries as rural messengers.

"The other day a call came to our telephone from someone in town who wished to talk with Mrs. Jinks, our tenant's wife. So my wife had to leave her sewing, don her sunbonnet and plod across the rough fields a third of a mile to tell Mrs. Jinks to come to the telephone. When Mrs. Jinks got ready she lumbered up to our house with a fat baby under each arm, and found out that Rosy, a friend of hers in town, wanted her to come and bring her out to spend the day.

"'Naw,' bawled back Mrs. Jinks; 'ain't got no hoss.'

"In a day or so another friend of the Jinks family telephoned out to say that she and three children would spend Sunday with the Jinkses, and Mr. Jinks must come in with the wagon to bring them out. My wife could not answer that the Jinkses had no horse, as they had just got one; so she promised to deliver the message. She gave the errand over to the Jinkses to me; I intended to attend to it, and forgot it. The folks in town got ready and waited all day Sunday, but no Mr. Jinks appeared. About Tuesday there was a great disturbance on the farm, involving all the Jinkses, my brother and myself, and both of our wives. The message hadn't been carried, and everybody was to blame.

"This is only a sample. We have other neighbors near and far; but our house is the telephone office of the district. People in town get mad at us, and people in the country get mad at us; our lot is hard."

Engineering at Colorado College.

Colorado College, at Colorado Springs, Col., will establish next year a school of engineering to cover five different courses, a general course and four special courses. The general course is intended as a non-professional course. The four special courses are: Civil engineering and irrigation; electrical engineering; mining engineering and sanitary engineering. A new science building is being erected and will probably be completed and equipped by the beginning of the next academic year.

The Sydney, Australia, Tramway System.

BY F. G. SYKES.

THE first electric tramway to be operated in Sydney was installed about 1890, and resulted from the conversion of a short steam line between Randwick and Waverly, which could not be made to yield a profit when operated with steam. This experiment was, however, soon discontinued, and the electrical apparatus removed to North Sydney, and erected at the terminus of the cable system as an extension of this system to Middle Harbor. The next development in the electric traction system of Sydney was the extension of the Ocean Street cable tram as far as Rose Bay.

This extension skirts the shores of Sydney Harbor, giving to passengers a view of a beautiful bit of scenery, and from an engineering point of view is remarkable for its steep grades and sharp curves. It is doubtful if any other source of power than electricity could have been successfully employed on this extension. The power was furnished by two 150-kw General Electric six-pole dynamos running at 400 r. p. m., and belted to the engines used for operating the cable cars.

In 1898 the first electric power plant of any size in Australia was built at Sydney, and known as the Ultimo power house. The current generated at this power house was to be used for operating the trams on George and Harris streets, in the center of the business section of Sydney.

Before this time, and with the exception of the short electric trams mentioned above, and the cable trams at North Sydney and Ocean Street, transportation to the various sections of the city was had mainly by means of steam trams, which not only proved very noisy and dirty, but were expensive to operate.

The conversion of these steam trams to electricity was kept in mind when the Ultimo power house was designed, and it was built with the idea in view of increasing it to a size sufficient for supplying the entire system, steam trams as well. While this article deals mainly with the large new power house just built, a brief description of the original one will probably prove of interest.

It is situated close to the tracks of the Government railways and only a short distance from the shores of Darling Harbor, from which a supply of salt water for condensing purposes is obtained. The building is of brick and steel construction, and arranged with the offices in front, and the engine and boiler rooms side by side behind the offices, thus allowing of their future extension. The engine room is 120 feet long and 96 feet wide; the boiler room being 120 feet long and 84 feet wide. The latter is provided with fourteen multitubular 300-hp hand-fired boilers, built by a local firm. Each boiler is 16 feet long and 7 feet in diameter, and has 72 tubes, 4 inches in diameter. The boiler settings are fitted with hot-air economizers. The engine room contains four 850-kw generators, direct connected to cross-compound horizontal engines built by the E. P. Allis Company, of Milwaukee, and arranged in two rows down the engine room. The engine high and low-pressure cylinders are 26 inches and 48 inches in diameter, respectively, with a 48-inch stroke, and their speed is 100 r. p. m.

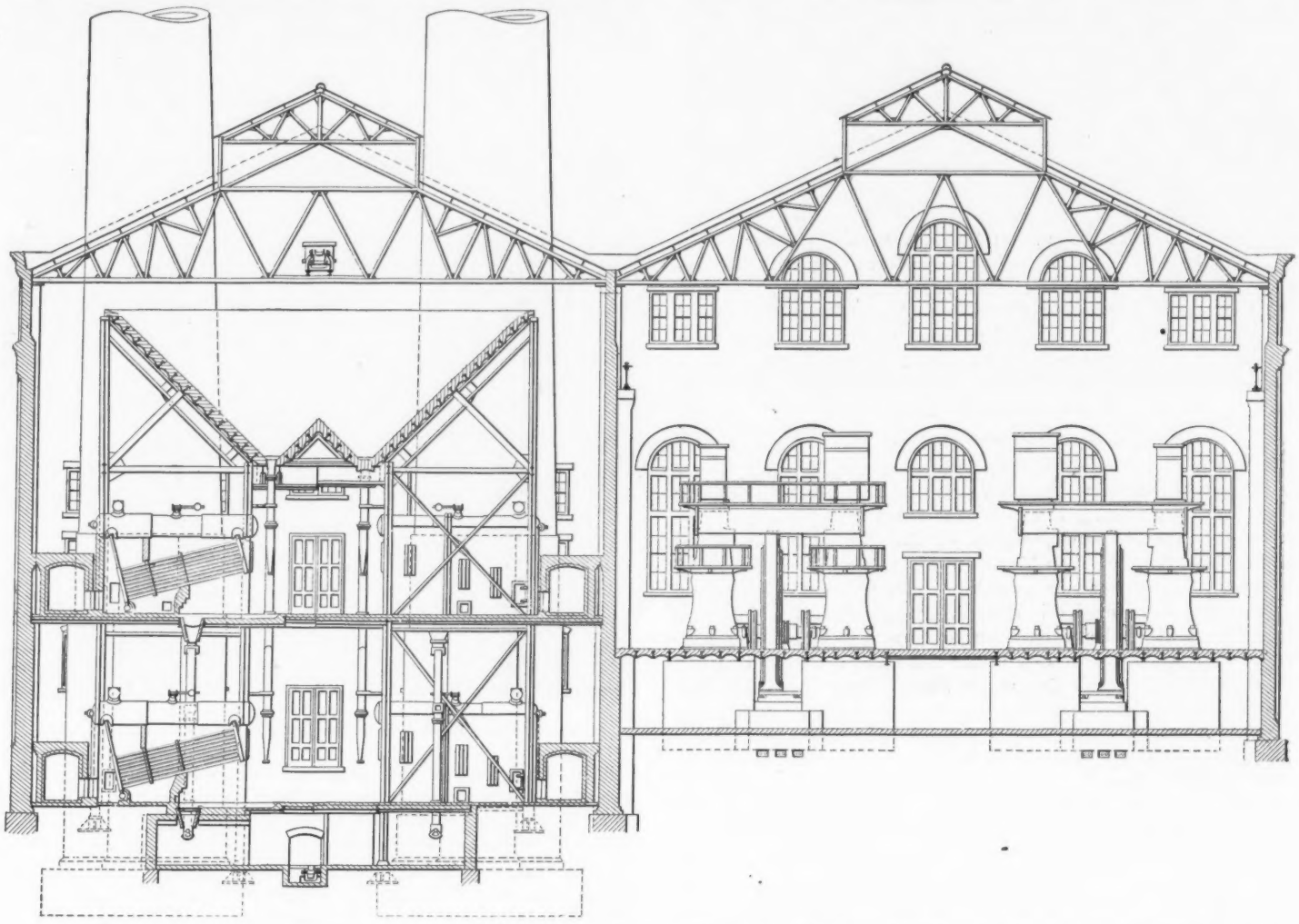


FIG. 1.—SECTIONAL VIEWS OF BOILER AND ENGINE ROOMS, ULTIMO POWER-HOUSE EXTENSION, SYDNEY, AUSTRALIA.

They are alternately right handed and left handed, so that one condenser may serve for two engines. The generators are of the General Electric railway type, compound wound, and need no description. The flywheels are of the compound type, reinforced with steel plates, and weigh about 40 tons each.

Blake centrifugal circulating pumps and Blake three-throw plunger feed pumps, all driven by 40-hp slow-speed motors, are located in the boiler room, while Blake steam-driven air pumps are used for the Wheeler surface condensers installed. The switchboard is located on a gallery at the end of the engine room nearest the offices, and was built by the General Electric Company. It is of that company's usual railway type, built of black enameled slate and consists of four generator panels, 17 feeder panels, 5 lighting panels, summation, booster and battery panels. The engine room is provided with two electric cranes

built by the Case Manufacturing Company, Columbus, O., each capable of lifting 30 tons, the span of each crane being about 48 feet.

Without even attempting the conversion of the steam trams to electricity, it was found that this station was almost immediately loaded to its utmost capacity. It, therefore, became urgently necessary to enlarge this power house and to provide the necessary new apparatus as soon as possible.

As some of the steam lines extend for quite a distance into the suburbs, with consequent long feeders, the question arose as to the advisability of increasing the present direct-current installation, or of making an entirely new departure, and providing alternating-current apparatus. With this end in view, the Chief Railway Commissioner, Mr. Charles Oliver, made a tour of inspection around the world. While in the United States, and acting on the advice of Mr. M. G. Starrett, of New York, as well as that of his engineers in Sydney, he decided on a three-phase, 25-cycle, 6600-volt system, using substations with rotary converters and transformers, and in August, 1900, signed a contract with the General Electric Company for the entire station and substation apparatus (except three-phase cable and storage batteries), including the steam machinery, which latter, however, was rebuilt. This machinery has been installed in Sydney, and is now in successful operation.

The general plan of the extension just installed is as follows: The original power house at Ultimo has been enlarged, and three 1500-kw generators with the necessary engines, boilers and other apparatus have been installed. Five substations have been built, one each at Newtown, Randwick, Waverly, Hunter Street and North Sydney. In each of these substations, with the exception of that at Randwick, there has been installed two 450-kw rotary converters, six 175-kw air-blast transformers, and two 500 ampere-hour storage batteries, each provided with a 50-kw booster set for charging purposes. Randwick substation is known as a "single unit" substation, as it contains only one rotary converter and one storage battery.

BUILDINGS AND CRANES.

The plans of the new building known as the "Ultimo Power House Extension" were drawn by J. G. White & Co., of New York, and the building is almost an exact counterpart of the Ninety-sixth Street power house of the Metropolitan Street Railway Company, of New York City.

The boiler room occupies two floors, one above the other, and the ground space occupied is 176 feet long by 84 feet wide. Two coal bunkers of steel construction, and capable of holding 2,500 tons of coal, are built directly under the roof, which is about 75 feet above the lower boiler room floor. Two chimneys have been built, each 224 feet high, and containing about 750,000 brick. Each top is covered with a cast iron cap weighing six tons, and made up of twenty segments.

The engine room is separated from the boiler room by a brick party wall, and is 176 feet long by 96 feet wide. It is lofty and well ventilated, and has foundations built for six units similar to those about to be described. The whole building is substantially built of brick, with brownstone copings, and the roof is built of steel trusses covered with corrugated sheet iron, a monitor being built over the engine room for ventilation.

The engine room is provided with an electric crane built by the Morgan Engineering Company, and having a hoisting capacity of 30 tons, with a span of 96 feet. It is of the box-girder type, provided with three G. E. railway motors and controllers for operating from a cage. It is also provided with electrical as well as mechanical brakes.

The substation buildings are brick structures with brownstone trimmings, very effective red tiled roofs, and are divided longitudinally into two parts, one part containing the rotary converters, etc., and the other part the storage batteries, a double interlocking door preventing the fumes from the battery room penetrating into the rotary room.

The battery room, which is 50 feet long by 40 feet wide, is in the double unit substations, two stories high, one battery being placed upstairs, and the other downstairs. The floor upstairs is covered with sheet lead, with the seams burned together, while downstairs the floor is of cement.

The rotary converter room is 50 feet long by 30 feet wide, built in one story, with a monitor at the top. This room is provided with a five-ton traveling crane, built by R. S. Scruttin & Co., of Sydney, and is also provided with a still, heated by a gas burner, for distilling the water for battery use. The floor is of cement, and is tiled around each rotary for a distance of about two feet, thus giving a very finished appearance to the machinery.

BOILER ROOM.

The boiler room contains 32 boilers, made by the Babcock & Wilcox Company, arranged to be set in batteries of two boilers each, eight batteries to be placed on the lower floor, and eight on the upper floor. Each boiler is rated at 450 hp, has 2,852 square feet of heating surface, and was built to operate under a steam pressure of 160 pounds per square inch. The front of each boiler is arranged for the reception of Babcock & Wilcox patent chain grate stokers. The coal is fed from the overhead coal bunkers by means of iron chutes, and feeds over the whole width of the grate, the thickness of the coal layer being regulated by the vertically sliding arrangement of fire doors. The stokers are operated by small engines connected by means of shafting and eccentrics. The John A. Mead system of noiseless coal and ash conveyors is in use, and consists, as is well known, of buckets mounted on wheels and operating on a steel trackway. The apparatus is operated by an electric motor, and includes a crusher operated by a second motor, and of 20 center dumping ash cars.

The feed water is forced from the hot well through two Goubert horizontal secondary feed water heaters, directly into the

FIG. 2.—BOILER ROOM, ULTIMO POWER-HOUSE EXTENSION.

boilers, by means of Worthington compound, duplex, outside-packed, plunger pressure-pattern boiler feed pumps. Three of these pumps are provided, each having two high-pressure steam cylinders 9 inches in diameter, and two low-pressure steam cylinders 14 inches in diameter; four single-acting outside-packed plungers 7½ inches in diameter, all of 10-inch stroke. Each of the above pumps is guaranteed to deliver 240 gallons per minute when running at a piston speed of 52 feet per minute on each side. The two feed water heaters are each provided with 1,500 square feet of heating surface, and are arranged so that the exhaust steam from the boiler feed, circulating and air pumps will be carried through the heaters.

The steam piping was furnished by the Best Manufacturing Company, of Pittsburg, and is laid out in accordance with the most modern ideas for combining simplicity with convenience and safety. Extra heavy piping and fittings were used, and ample provision was made for expansion by using wrought iron bends. The "unit" system has been employed, and the piping for each unit is as far as possible identical.

ENGINE ROOM.

The engine room is provided with three main engines built by the Allis-Chalmers Company, and placed in a row on the side of the room next to the boiler room. Each engine is a vertical, cross-compound condensing machine of the Reynolds-Corliss type, with high-pressure cylinder 32 inches in diameter, and low-pressure cylinder 64 inches in diameter. Both cylinders

FIG. 3.—ENGINE ROOM OLD ULTIMO POWER-HOUSE, SYDNEY TRAM SYSTEM, AUSTRALIA.

FIG. 4.—ROTARY CONVERTER ROOM, WAVERLY SUB-STATION.

THE SYDNEY, AUSTRALIA, TRAMWAY SYSTEM.

FIG. 5.—HIGH-TENSION CABLES.

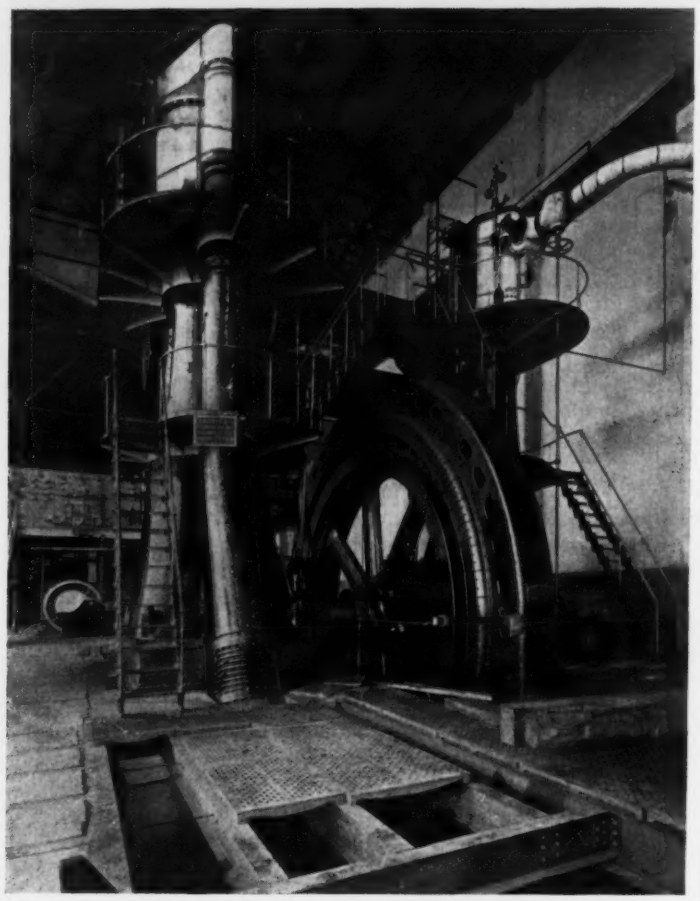


FIG. 6.—ENGINE ROOM, ULTIMO POWER-HOUSE EXTENSION.

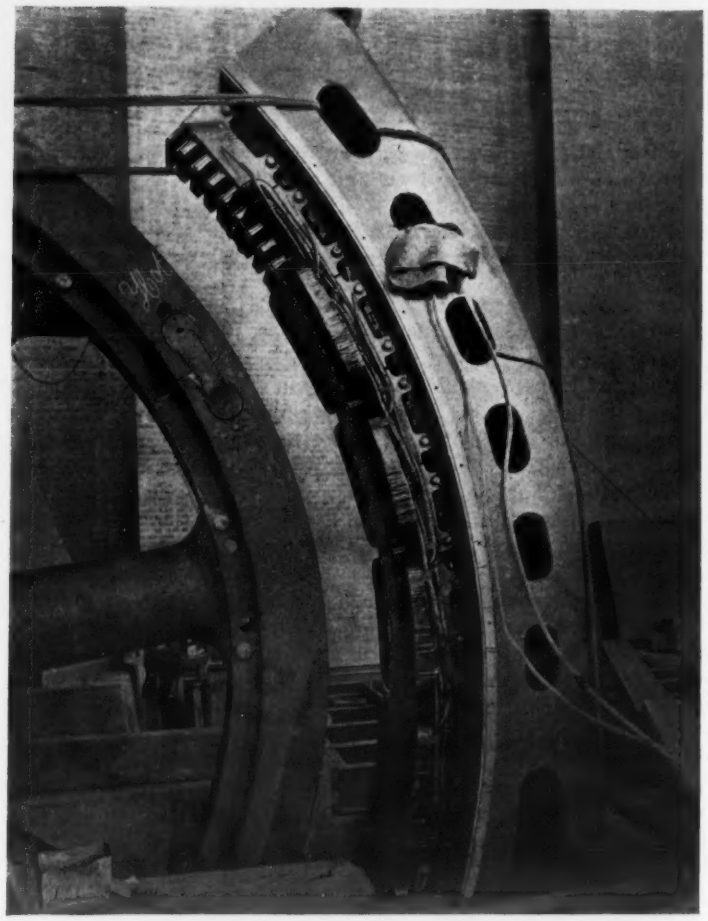


FIG. 7.—SECTION OF GENERATOR ARMATURE AND FLY-WHEEL, ULTIMO POWER-HOUSE.

have a stroke of 60 inches, and operate at 75 r. p. m., with 150 pounds steam pressure. The steam from the boilers is led directly into a Reynolds separator placed in the basement, flowing from there into the high-pressure cylinder, and thence through a receiver and reheater into the low-pressure cylinder. A small motor is provided for controlling the speed of the engine within two per cent above or below normal, and is controlled by the switchboard attendant. Each engine is also provided with an auxiliary governor attached to a stop valve, located next to the throttle valve, and so arranged that should the engine from any cause speed up five revolutions above the normal, the valve will be instantly and positively closed, shutting off all steam from the cylinders.

Two 150-hp horizontal tandem compound engines made by the Harrisburg Foundry and Machine Works, operating at 270 r. p. m., and each direct connected to a six-pole, 100-kw, 125-volt, compound-wound generator, are located between the main engines and the high-tension switchboard gallery. These engines are equipped with an automatic self-lubricating device, whereby the bearings on the engine frame, crank pin, crosshead pin and guides, will be lubricated from a reservoir of pure oil, which constantly seeks its level, in the engine base beneath the crank pin. The crank delivers the oil from this reservoir in a continuous supply to the crank pin, from which it is thrown off by centrifugal force into a pocket provided in the inside of the oil hood, and from this pocket flows through tubes to the crank shaft bearing and thence back to the reservoir.

Each main engine is provided with a Worthington surface condenser, which, together with its air pump, is located in the engine basement close to its respective engine foundation. Each condenser has a total of 3,600 square feet of cooling surface, and is guaranteed to produce a vacuum of 26 inches of mercury.

Adjacent to the condenser is located a Worthington vertical compound beam air pump, having its steam cylinders of 9 inches and 16 inches diameter, and its air buckets of 20 inches diameter, with a common stroke of 12 inches.

The circulating pumps are placed in the boiler room, and are of the Worthington horizontal compound, outside packed plunger type. The salt water used for condensing purposes is pumped from Darling Harbor, and the piping is so arranged that any circulating pumps can supply any condenser with cooling water.

The two condensers for the exciter engines are similar to those for the main engines, except that they are smaller and are provided with combined air and circulating pumps attached to the same steam cylinder. A gravity oiling system is provided for the main engines.

ELECTRIC GENERATORS.

Direct connected to each of the three Allis engines just described is a General Electric 1,500-kw, 6,600-volt, three-phase generator, running at 75 r. p. m. These generators have their armatures stationary, while the field poles are attached directly to the periphery of the engine flywheel, thus making a very compact generating unit and reducing to a minimum the weight on the engine shaft.

The flywheel hub and spider is a casting in two parts, and the hub is fastened to the shaft by means of six long bolts through the hub, and tightened in place while hot. The rim is made up of eight cast-steel segments, four of which are equal to the circumference of the wheel, the other four being placed beside the first four, but arranged to break joints. Forty field poles, which at 75 revolutions, will give a frequency of 25 cycles, are bolted to the outer face of the engine flywheel rim, the bolts passing right through the rim of the wheel. Exciting current is led by means of two cables fastened to one of the spider arms, from the collector rings on the shaft to the field winding. The stationary armature is divided into four parts for convenience of shipping, which are bolted together as they are assembled. The internal diameter of the armature when assembled is 280 inches. The coils are rectangular in form, wound on forms, and placed in the slots as the armature was assembled in the Ultimo power house.

HIGH-TENSION SWITCHBOARD.

The switchboard is located on a raised gallery across the dynamo room, between the old and the new portions of the station. Space is provided on this board for controlling three exciters, two of which are now installed, six three-phase generators, three of which are at present installed, and five substation feeders, all of which are now installed, although as they are at the end of the board, future feeder panels can be installed without disturbing the rest of the switchboard. There is also an exciter summation and a generator summation panel. The instruments and low-voltage controlling apparatus are mounted on blue Vermont marble panels, while the high-tension parts, consisting of switches, busbars and transformers are placed some distance behind the operating board.

Each generator and feeder is controlled by three oil switches, all three connected to a common shaft, which is operated by a lever from the front of the operating board by means of rods and bell cranks. Each of these oil switches is placed in a separate brick comparment, so that any arc which may be accidentally formed in one compartment cannot be communicated to the others. All of the generator switches are provided with reverse current relays, which light up a red lamp on the front of the board should any reversal of current take place, but do not trip the switch, as this is not thought advisable.

All of the feeder switches are provided with overload relays, which in addition to tripping the switch, should the current rise above a predetermined amount, also light up a red lamp on the front of the board, thus drawing the attendant's attention to this switch. Each generator panel is provided with a recording and an indicating wattmeter, a main ammeter and voltmeter, and a field ammeter. Each feeder panel is provided with a recording wattmeter and three ammeters, one for each phase.

The generator summation panel is provided with one recording wattmeter, three ammeters and three voltmeters, thus showing the grounding or unbalancing of any phase. Two indicating wattmeters are also provided, enabling the instantaneous power factor to be determined.

All of the ammeters, voltmeters and indicating wattmeters are of the General Electric horizontal edgewise type, with black enamel finish, while the recording wattmeters are of the round pattern, balanced induction type. Synchronizing arrangements are provided, using both a voltmeter and a lamp, the generators being in exact synchronism when the lamp is dark and the voltmeter reads full voltage.

The exciters are provided with astatic ammeters and voltmeters, while the exciter summation panel is provided with a Thomson recording wattmeter. Both the exciter and generator field rheostats are placed in the basement, and controlled by means of a long shaft with gearing.

All parts of the boiler and engine rooms, engines, switchboard gallery and offices are provided with telephones and signal lamps, all under the immediate control of the switchboard attendant, while he also has communication with each of the substations by duplicate telephone lines.

THREE-PHASE CABLES.

Each of the various substations is electrically connected with the switchboard at the Ultimo power house by means of a duplicate set of three conductor cables furnished by the British Insulated Wire Company. The system in use is the solid laid system so common in Europe, and the cables are placed in wooden troughs and surrounded by an insulating material. Two wooden troughs made of well seasoned iron-bark, an Australian hardwood, which were coated with Stockholm tar, were placed in a trench dug to a depth of about three feet below the surface of the street. One of the troughs, in which the high-tension and 600-volt feeder cables are laid, is about 8 inches deep by 11½ inches wide, while the other trough intended for the return cables is 5 inches deep by 6 inches wide. The cables when laid are supported by bridges of wood, and surrounded by a compound, composed of Stockholm tar, resin and sand, the trough being then covered with an iron bark plank, held in place by three layers of common brick. Each phase of the three conductor cable is composed of 19 No. 16 B. W. G. wires (equivalent to about No. 4—6 B. & S.), stranded together and insulated with 7/32-inch paper, the entire three conductor cable being covered first with 6/32-inch paper, then with lead, and outside of all with impregnated jute. The section of the cable running to the North Sydney substations is laid under the waters of the harbor, and this cable is armored in addition to the cov-

ering stated above, with two layers of No. 11 S. W. G. steel wire, and outside of this with a covering of impregnated jute.

Wirt alternating-current short-gap lightning arresters are provided, both at the Ultimo and substation ends of each duplicate feeder, for taking care of any electric surgings which may be set up in the feeders due to sudden heavy changes of load, or short circuits.

SUB-STATION APPARATUS.

As all of the substations are identical a description of the Waverly substation, shown in Fig. 4, will suffice for all. As stated above, the rotary converter room is provided with two six-pole, 450-kw rotary converters running at 500 r. p. m.

These machines are of the G. E. railway type, and are too well known to need description, except to say that they are provided with four-pole 40-hp induction starting motors. The rotor of these motors is forced directly on an extension of the main armature shaft, and is of the squirrel-cage type. The stator is mounted on a bracket, which is bolted to the pillow block on the collector ring side of the machine.

The 6,000-volt currents upon entering each substation, and after passing the high-tension switchboard, are conducted to two sets of three 175-kw delta-connected air-blast transformers, where the voltage is transformed from 6,000 to 375 for use in the rotary converters. These transformers are cooled by a blower set consisting of a 1-hp induction motor direct-connected to a steel-pressure blower.

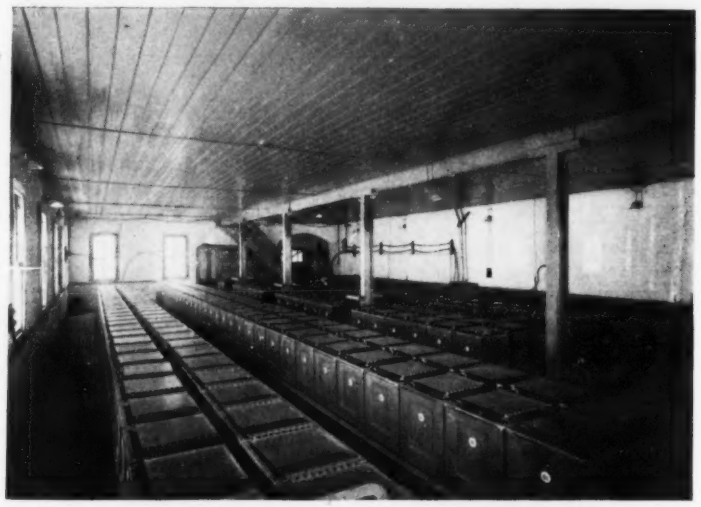


FIG. 8.—BATTERY PLANT, WAVERLY SUB-STATION.

The high-tension switchboard consists of two blue Vermont marble panels, in each of which are mounted a horizontal edgewise voltmeter graduated to read to 8,000 volts, and the switch handles. The switches, which are of the oil type, are placed in brick compartments, located some distance behind the marble panels. These switches are arranged to trip on an overload by means of relays, a red lamp placed in the front of the marble panel indicating when the switch is open. The 600-volt switchboard is of the ordinary railway type, built of blue Vermont marble, and provided with astatic instruments, circuit breakers, etc.

In each battery room is located a storage battery built by the Accumulatoren-Fabrik Aktiengesellschaft, Berlin, and consisting of 280 cells. Each cell contains 10 negative and 9 positive plates, and is made of wood lined in the inside with sheet lead. The cells are mounted on a wooden platform, built up of three 11-inch hardwood timbers, placed on edge and floored over. This platform is insulated from the floor by glass blocks, and each cell is insulated from the wooden platform by porcelain insulators, four under each cell. The guaranteed capacity of each battery is 500 ampere-hours. The charge and discharge of the battery is regulated by means of a differentially-wound 50-kw booster direct-connected to a 100-hp multipolar motor running at 900 r. p. m.

GENERAL.

The Sydney and Suburban tram system comprises about 145 miles of track, and operates 527 cars. In the center of the city along George and Harris streets, center pole construction with double bracket arms and cast-iron ornamental bases set in concrete, is used, while all other parts of the city have span wire construction using both wood and Mannesmann steel poles. The track construction consists of grooved girder rails weighing about 83 pounds per yard, laid on concrete foundations with a wood block roadbed. Both Brown plastic and Washburn & Moen solid crown bonds are used for bonding, together with copper cables .45 square inch cross-section, laid between each track and bonded to alternate rails. These cables are laid against the inner rails of their respective tracks, and the two tracks are cross connected every 60 yards. The trolley wire used is of figure-eight section, about 0.13 square inch in cross-section.

Two types of cars are used, one of them being built by the Brill Company, while the other is built by the Clyde Engineering Company, of Granville, Australia. Both Peckham and Brill trucks are used, while the cars are braked by means of the Christensen air brake, the desired amount of compressed air being secured by means of a compressor placed upon the axle and operated by the rotation thereof.

The entire system is under government control, and is operated by three commissioners appointed by the Premier of New South Wales for a term of seven years.

The manner of collecting fares is that in use in most European cities, and consists in dividing the city into sections, a charge of a penny (2 cents) beng collected for each section traveled over. Different colored tickets are issued by the conductor for the various sections, the passenger either paying for one section at a time, or he can pay for the entire distance he wishes to go at once. Each ticket is numbered, and inspectors are likely to inspect each passenger's ticket at any time, thus reducing the chance of dishonesty to a minimum.

Sydney can now boast of having the largest electric tram system in the southern hemisphere, and I may add that it is expected to double the equipment in the near future.

German Electrical Conditions.

Writing from Berlin under date of November 18, a special correspondent of the New York *Evening Post* says: "Germany's electrical industries, which had thus far formed a strong bulwark against the tide of depression, are the last to yield, and acknowledge large losses. Simultaneously with the era of industrial prosperity in Germany, the electrical industries scored one commercial and technical triumph after another. But the buoyancy and prosperity took the form of stock speculation, with the result that several very large companies have already been forced to the wall by creditors and despairing shareholders. Over-capitalization and a too strenuous race for export conquests, at the expense of the reserve funds, have caused a general reaction which was perhaps too long in coming.

The past week has been chiefly eventful because of the symposium of gloomy financial reports submitted by leading electrical companies. The Schuckert Company, which was forced to undergo a thorough process of "sanitation," reports a loss of 21,000,000 marks for the last year, and within a few days the stock was quoted materially lower. The Allgemeine Electricitäts Gesellschaft, which was regarded as the most impregnable, now publishes a statement of expenses and dividends which shows more eloquently between the lines the hard struggle to present an encouraging balance sheet. The dividend of 8 per cent., declared several days ago, is misleading, for the reason that 2½ per cent. is added by transferring a part of the operation fund to the dividend account. The Kummer Company shows a loss of 20,000,000 marks in operations, the Helios Company, of Cologne, of over 9,000,000 marks."

A cable dispatch from Berlin of November 29 says: "A combination of several electric concerns has been effected for the purpose of underbidding American competition. The members of the combination are the Allgemeine Electricitäts-Gesellschaft, Siemens-Halske, of Berlin, and the Schuckert Company, of Nuremberg."

Speed of Pacific Cable.

A recent telegram from Vancouver, B. C., says: "Advices from Banfield Creek state that a speed of a hundred letters a minute has been attained on the British Pacific cable." That sounds rather encouraging.

Telephone Cables—I.

BY ARTHUR V. ABBOTT, C. E.

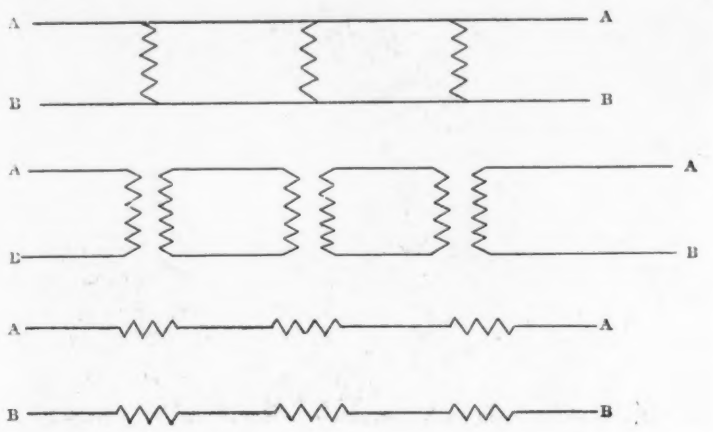
THE PRINCIPLES OF CIRCUIT DESIGN.

OF all of the diverse parts of a telephone system, the conductors connecting the substations with the central office have recently received the least attention. Substation apparatus exhibits itself in a thousand forms, and each issue of the Patent Office Gazette adds to the number. Upon the switchboard and its appliances hosts of inventors have expended their skill, but the metallic road over which messages travel has remained for more than a decade almost unnoticed. As soon as the rapid multiplication of circuits pointed inevitably to underground lines the question of insulation became of paramount importance. The first expedient was to follow the lead of telegraph engineers and lay cables insulated with gutta percha or some of the rubber compounds. Such cables were expensive to install, and even more costly to maintain, as under the trying conditions of urban conduit service, the rubber soon deteriorated. Moreover, the transmission of speech was seriously impaired. Present knowledge of the properties of electrical conductors is much clearer than in the early 80's. But even at that time it was recognized that the resistance of a conductor, and its electro-static capacity, were important factors in speech transmission. The use of the smaller wire naturally employed in cables made an increase in resistance, while the rubber insulation and closer proximity of wires vastly augmented capacity. Observing this marked inferiority in speech transmission, Sir William Preece formulated his famous KR law, a proposition to the effect that unless the product of the capacity and resistance of a telephone line was less than a certain quantity (from 5,000 to 10,000 for open wire circuits, and about 8,000 for cables) the line would not talk. Some lines on the continent of Europe and the first wires from New York to Chicago in the early 90's so built as to make this product greater than the assigned limiting values did talk, and talked fairly well; so the faith of electricians in the KR rule was shaken. Meanwhile, the invention of the Patterson cable placed in the hands of the telephonists a form of underground circuit at once so cheap, so durable and so efficient that it is perhaps not strange that the cable problem was regarded as completely solved, and attention was directed to other fields.

While an extended exposition of the properties of electrical circuits is not only foreign to the scope of these papers, but from its necessarily mathematical character repugnant to the reader, it seems best to roughly sketch the governing factors in order that the principles of circuit design may be comprehended.

Imagine a force pump connected to a line of very elastic hose. If the length of this pipe be very short, each stroke of the pump will be followed by a jet of water from the delivery end exactly corresponding in all respects, save a slight loss in energy due to the friction of the pipe walls, to the motion of the pump plunger. But if the hose be long all the conditions are changed. Before any water can be ejected from the remote end of the pipe, the inertia of the entire water column must be overcome, and if the strokes of the pump plunger be sharp and sudden the first effect is to distend the hose near the pump. The result is an increase in the quantity of water contained in the pipe, and the absorption of some of the energy delivered by the pump in the elastic reaction of the walls of the hose, and the water travels along the pipe as a wave, or pulse. If the pump strokes are very short and quick and the pipe large, long and very elastic, it is conceivable that the character of the pump pulsations might be completely changed by the time they arrived at the delivery end, and the form of the water jet transformed from a series of short, quick squirts to a flow more or less steady. In many respects electrical circuits behave in a similar manner, and in the design of telephone conductors, the length of the circuit is an important factor. If lines are of sufficient length, say something more than 15 or 20 miles, so that the energy transmitted as electricity is compelled to proceed as a series of waves, all of the laws pertaining to wave transmission will apply to, and must be recognized in the design of such circuits. If on the contrary, lines are too short to permit the establishment of impulses, the laws of wave action need not be taken into account. In short lines the impulses impressed at one end by the transmitter are received at the other end substantially unchanged in all of their characteristics save a slight energy loss occasioned by the ohmic resistance of the circuit, a quality analogous to the frictional resistance of the water pipe. Contrariwise, if the circuit be long, the energy transmitted proceeds as a series of waves, and under such circumstances the character of the impulses impressed by the transmitter may be completely changed by the action of the longer conductor. In order that articulation may be readily understood, and to enable one to recognize the voices of friends and acquaintances the harmonics, or over tones, in which all speech abounds must be clearly preserved, and it is these ripples upon the vocal sound waves, like the quick, short strokes of the pump that are easily obliterated by the elastic reactions of the electrical conductors over which they travel.

In the analogy, if by any means the elasticity of the pipe could be destroyed, then as the contained water column is inelastic, the strokes of the pump would be delivered at the receiving end unchanged in quantity and in quality. It was an attempt to recognize and to deal with this, at that time but dimly understood relationship, that caused Sir William Preece to formulate the KR law, indicating the impracticability of speech over lines in which the product of the frictional resistance and the elastic reaction exceeded a certain constant. In the hydraulic analogy, such a result would be obtained by substituting a rigid pipe, say, iron, for the rubber hose. Electricians have long known that electrical circuits possessed the property of inductance that was opposed to, and could be made to neutralize, capacity. More than a decade ago Mr. Heaviside showed mathematically that the addition of inductance to a telephone circuit in the shape of a wire coil should improve its talking proper-



FIGS. 1, 2 AND 3.—CORRECTING INDUCTANCES ON TELEPHONE CIRCUITS.

ties, but when he attempted to carry out experimentally his mathematical deductions by inserting inductances concentrated at one or two points the results were disastrous, for lines which had talked passably prior to the introduction of the reactance coils, subsequently refused to transmit a syllable. In 1893, Dr. S. P. Thompson* in a paper entitled "Ocean Telephony," showed that as the capacity of a circuit was uniformly distributed along its entire length it was necessary to similarly distribute the correcting inductances, instead of concentrating them as Mr. Heaviside had done. Dr. Thompson showed two methods for using correcting coils; one plan is illustrated in Fig. 1, in which the coils are placed as shunts across the line at frequently recurring intervals. The other plan, Fig. 2, consisted in introducing transformers, thus splitting the line into a number of sections. As the perturbing action upon voice currents varies as the square of the length of the circuit, such frequent sub-division improves transmission by the simple process of cutting up a long circuit into a number of shorter ones, and by properly designing the transformers they may be made to balance out the capacity of line and act in the same manner as the inductive shunts. This effect Dr. Thompson's paper does not clearly specify, and while he showed a number of methods of building lines whereby their talking qualities may be improved no data is given as a basis for actual design. On December 12, 1893,[2] two patents were issued to Mr. C. J. Reed that embrace exactly the same features as are shown in Dr. Thompson's method. As Mr. Reed's applications were filed nearly

* See proceedings of the International Electrical Congress, page 143.

[2] See patents 510,612, dated December 12, 1893, 510,613 dated December 12, 1893.

a year prior to the International Congress, he must be regarded as a co-inventor or prior to Dr. Thompson. But Mr. Reed's patent gives no specifications as to building or using the transformers, and the language of the patent leaves some doubt as to whether he was fully aware of the possible effect of his invention on the talking properties of telephone circuits.

So it has been reserved for Dr. M. I. Pupin to prove both mathematically and experimentally the truth of the Heaviside theory, and to show that his practice was defective only in the design and location of the balancing inductances. Moreover, Dr. Pupin has gone a step farther than all prior inventors in accurately describing both the way to place the balancing inductance coils, as shown in Fig. 3, with reference to the waves transmitted by the circuit, and the design which should be adopted in their manufacture, in order to secure the best results. Those who are interested in this branch of the subject can do no better than to study carefully Dr. Pupin's papers before the American Society of Electrical Engineers,[3] or to peruse his patents.[4]

Consider whether the hydraulic analogy will not explain the cause of Mr. Heaviside's failure. Suppose in order to counteract the elasticity of the hose one or two iron rings should be clamped about it. Doubtless these rings would have sufficient strength to confine all the energy imparted by the pump, but this restraining action would be restricted to their immediate vicinity, while the remaining and by far the greater portion of the pipe would still possess its original and undesirable elastic qualities. Now when a pump pulse travels along the pipe and reaches one of the confining rings, it cannot here distend the hose, and the wave is suddenly checked in its course, and a portion reflected back upon itself just as on the seashore the retiring breaker interferes with, and confuses the advancing wave. The confining ring thus not only fails to prevent the deformation of the pump pulse by destroying the elasticity of the hose at certain points, but it adds to the existing confusion by reflecting the water wave on itself and setting up interference waves. To the best of our present knowledge the Heaviside coils acted in a similar manner, for while they tended to neutralize the capacity of the circuits in which they were placed, they were so located as to concentrate an excess of balancing action at one or two points, and instead of effecting an improvement set up a series of interference waves which added to the existing distortion. To return to the hydraulic analogy, if for the one or two heavy iron bands a large number of light wire hoops should be placed at frequent intervals along the entire length of the hose, the effect would be much the same as the substitution of a rigid material for the elastic walls of the hose, and the result at the receiving end would be jets of water co-ordinated with the pump strokes in shape and in time.

From this rough analysis it is seen that to properly design an electrical circuit one must regard its length in connection with the mutual relations of resistance inductance and capacity. If the circuit be shorter than the electrical wave length of the impulses it is called upon to transmit there will be no chance for true waves to be formed, and consequently the deforming action just described will not occur, and ordinary transmission in which ohmic resistance is a greater factor takes place. It is probable that voice impulses give rise to few important waves less than 15 miles in length, and consequently in dealing with shorter telephone circuits the effect of wave transmission may be neglected. But when it becomes necessary to consider toll lines running into scores, hundreds or thousands of miles the wave character of the transmission becomes the governing factor.

Subscribers' lines in the larger and telephonically denser cities will not exceed half a mile in length, and in the smaller ones a mile or a mile and a quarter. But few trunk lines even in the largest exchanges are more than five or six miles long, so that in the design of single exchanges the question of wave transmission may be neglected, and circuits proportioned solely from the standpoint of resistance and capacity. Yet it must not be forgotten that as the telephone systems of the country develop, toll line communication will rapidly increase, and so the wire plant for each single office must be based on the probability that in the near future its circuits will be called upon to work in combination with toll lines which will be measured by hundreds of miles.

[3] Trans. Am. Ins. Elec. Engs., Vol. xvi, 1899, p. 93 and Vol. xvii, 1900, p. 445.

[4] Patent No. 652,230, June 19, 1900 and No. 652,231, June 19, 1900.

At present the use of balancing coils in long lines is still in the experimental stage, little or no extended practical experience having been gained therewith, while toward the improvement of transmission over underground cable little has been done beyond laboratory tests. That telephone circuits are soon likely to undergo considerable modification in design, which will result both in less expensive construction, and improved transmission seems certain, though it is difficult to forecast precisely the way in which such a result will arrive. There is no doubt of the wisdom of reducing resistance and capacity in all circuits to the lowest commercial limits, and this goal is to-day the aim of cable designers. The operation of resistance is to transform a portion of the electrical energy carried by the circuit into heat, which is radiated away, and, so far as speech transmission is involved, utterly lost. The amount of energy thus wasted is directly proportional to the square of the current, and the resistance of the conductor. Over conductors of high resistance therefore speech transmission becomes *faint,* but the clearness of articulation is not impaired. Therefore to secure *loudness* in transmission large conductors of material of good conductivity must be employed.

The practical effect of capacity is to prevent successful transmission not so much by decreasing *loudness,* as by interfering with *distinctness,* thus b's and p's, s's and c's sound alike at the end of a high capacity line, and it is difficult to distinguish one word from another, causing frequent repetition. Capacity depends on the area of the conductors, their proximity to each other, and the character

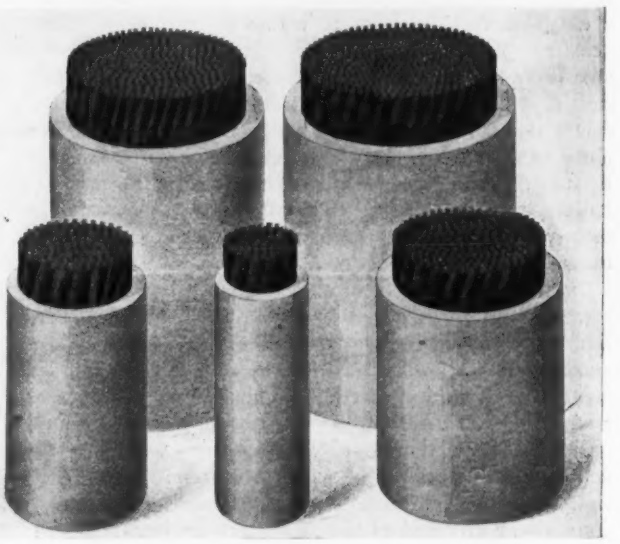


FIG. 4.—PAPER-INSULATED CABLES.

of the insulating material that separates them. The larger the wires of any circuit, and the nearer they are together, the greater the capacity. Air has about the lowest specific capacity of any known substance, so that the use of *any* other kind of insulating material necessarily increases capacity, thus the result of placing circuits in cables has a fourfold effect on transmission.

1st. The use of smaller wire increases resistance and decreases volume.

2d. The use of smaller wire decreases capacity and improves articulation.

3d. Twisting the circuits together brings the wires nearer to each other, increases capacity and injures articulation.

4th. The necessary use of some insulating material besides air, increases capacity and injures articulation.

The net result is a perceptible decrease in volume when long lengths of cable are used, and a very marked impairment in distinctness, even over moderately long lines. The aim of the cable designed should therefore be:

1st. To use the largest wire compatible with reasonable installation cost.

2d. To place the component parts of each circuit as far apart as possible.

3d. To use a minimum insulating material other than air.

The invention of the Patterson, paper, dry core, or air spaced cable, as it is variously called, closely realizes these conditions. Several sizes of this cable are shown in Fig. 4. Copper wire of No. 19, B. & S. gauge, has been the usual size of the conductors. The

requisite number of pairs to form the desired cable is taken, and each wire insulated from its twin by a loose wrapping of carefully dried paper. It is customary to color in some distinguishing manner the paper on the individual wires in order to avoid the frequent testing otherwise necessary to distinguish the components of each one. One method of applying the paper is shown in Figs. 5 and 6, from which it is seen that the wires are simply separated by a sheet of paper, and then lightly twisted together, this twist being sufficient to hold both the conductors and the insulation in their proper relative positions, serving at the same time the very important office of preventing cross-talk due to the mutual operation of electrostatic and electro-magnetic induction. A single twisted pair is taken to form the core or nucleus of the completed cable, and around that the requisite number of pairs are

FIG. 5.—ONE METHOD OF APPLYING PAPER TO CONDUCTOR.

assembled in regular layers, each successive layer being "cabled" or wound about the preceding one with a reversed twist, making a complete turn in from 18 inches to 36 inches. This process of "cabling" operates again to eliminate cross talk between successive layers. The use of the paper to separate the individual wires furnishes an insulator of low electrostatic capacity, and yet of sufficient resistance to maintain an insulation of many thousand megohms against the feeble electromotive forces of telephone currents. By twisting the various pairs of wire and the several layers very loosely about each other a considerable volume filled with air remains, and capacity is decreased by preserving as much space between conductor as possible.

To maintain such an arrangement of wires in working condition some protection is absolutely necessary as the insulating material is not only hygroscopic to the last degrees, and would retain its insulating properties for but a short time after being kiln dried, but is also of fragile character, and could not resist an infinitesimal amount of the handling needed to place circuits in their working position. Protection is achieved by enclosing the paper covered conductors in a lead pipe, which, if carefully made is absolutely air tight, sufficiently flexible to be readily introduced into underground conduits or attached to pole lines, and indestructible under the corrosive influences usually encountered.

Not only must the successful cable talk well, but it must be reasonably easy and economical to manufacture, its mechanical attri-

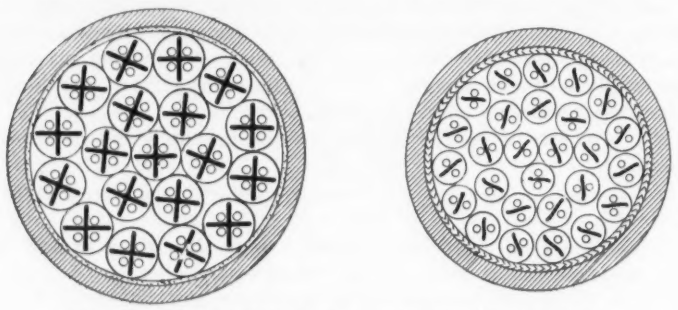


FIG. 6.—CROSS-SECTIONS OF PAPER-INSULATED CABLES.

butes must meet the conditions of every-day service, and its design must be such as to make any desired rearrangements of circuits easy. About a dozen years ago the American Bell Telephone Company issued the famous "Conference Specifications," embracing the consensus of existing opinion as to the method of telephone cable building, and under which the bulk of all the telephone cable now in use has been constructed. The essential characteristics of the Conference Specifications are as follows:

Sizes.—Number of pairs, 25, 30, 50, 60, 100, 120.

Conductors.—Copper 19 B. & S. gauge, conductivity 98 per cent of pure copper.

Insulation.—Dry paper.

Conductor Arrangement.—Twisted pairs, length of twist not over 3 feet.

Core.—Laid up in successive reversed layers, with a lay of at least 1 turn in 2 feet.

Seal.—The end of each length sealed with insulating material for at least 2 feet.

Sheath.—The cores to be enclosed in a lead pipe ⅛ inch thick, having at least 29-10 per cent of tin.

Electrostatic Capacity.—Shall not average more than .080 microfarads per mile.

Insulation.—100 megohms per mile.

Guarantee.—Capacity shall not increase, nor insulation decrease for five years.

The cables produced by these specifications so completely filled all requirements that it is only within the last two or three years that there have been any symptoms of departure from the good old Conference standard. But telephony is extending rapidly in both scope and quantity, wire ways are becoming congested, competition is demanding greater economy in construction and better service to the subscriber, and it appears possible to introduce considerable economy in the cost of wire plant by building cables specifically adapted for the service demanded of them.

At the end of 1901 the approximate statistics for the telephone industry were as in Table I.:

TABLE I.—TELEPHONE STATISTICS, YEAR OF 1901.

No. of Stations	2,300,000
No. of Offices	6,500
Originating calls per day	12,500,000
Toll messages per day	275,000
Per cent toll messages to originating calls	2.2
Per cent trunk messages to originating calls	34.0
Total wire, miles	3,000,000
Aerial wire, miles	1,100,000
Cable wire, miles	1,900,000
Toll line wire, miles	260,000
Per cent. trunk miles to subscriber, miles (when there is more than one office in an exchange)	30.00
Per cent of toll line wire to total wire	8.6

From the table it appears that the toll lines constitute only about 8.6 per cent of total telephone lines, and handle but 2.2 per cent of the total business. While doubtless this proportion will very rapidly increase, and the importance of toll traffic to general telephone business is fully realized, the advisability of designing subscribers' line, trunk lines and toll lines each for its own particular sphere is clearly shown. In 1898 or 1899 the 120 pair cable of No. 19 wire was the almost universal standard, but the rapidly increasing congestion of wire ways is forcing more economical use of space, and 200 and even 400 pair cables have appeared. The standard 120 pair cable had a resistance per circuit mile of 94 ohms, and a capacity of .08 microfarads per mile. Experience has shown that commercial transmission can be carried on through something over 25 miles of such cable, or, in other words, acceptable service can be given through a line having a resistance of, say, 2,,300 ohms, and a capacity of 2 microfarads. Any rearrangement of wire plant that does not interpose a greater resistance and capacity, will, therefore, afford equal service. As subscribers' lines are short, more numerous, and comprise about two-thirds of exchange wire mileage, it would seem feasible to use cable of small wire, and consequently cheaper construction for this part of the wire plant, and for the trunk lines and toll line install circuits of larger wire and better talking properties, thus securing good transmission and reducing installation cost. To illustrate: Compare the expense and electrical properties of two plants, one installed with standard 120 pair cable, and the other having 400 pair cable No. 22 wire for subscribers' lines, and 75 pair cable No. 18 wire for trunk line. The properties of such cables will be about as in Table II.

TABLE II.—COMPARISON OF CABLE PLANTS.

No. of pair	75	120	400
Size of conductor B. & S.	17	19	22
Resistance per circuit mile in cable	59	94	187
Capacity per mile	.065	.080	.112
Cost per active pair mile	$83.00	$52.00	$21.00

To compare probable transmission assume an exchange where the telephonic density is such as to make the average subscribers' distance from the office half a mile, and the average trunk line length five miles. Such conditions now represent about the aver-

age of the larger cities. Then a comparison between the two plants will be as in Table III.

TABLE III.—COMPARISON OF ELECTRICAL PROPERTIES OF WIRE PLANTS BUILT WITH CABLES AS IN TABLE II.

	120 Pair Cable	75 and 400 Pair cable	Per cent. change
Resistance of two subscribers lines in the same office	94 Ohms	187 Ohms	199.5
Capacity of two subscribers lines in the same office	.080 Mfs	.132 Mfs	1050.0
Resistance of two subscribers lines in different offices	564 Ohms	482 Ohms	85.5
Capacity	.480 Mfs	.437 Mfs	91.0
Cost	1	.695	69.5

By the preceding table it is clearly shown that the 400 pair cable will *not* give a good transmission between subscribers taking in the same office as a No. 19 wire cable will. But as the total resistance and capacity of two such lines is very small a reasonable increase in the objectionable electrical properties is unnoticeable, as the permissible margin is *very large*. Passing to trunk line conversations, it is shown that the combination of the 400 pair No. 22 wire cable and 75 pair No. 18 wire cable decrease resistance to 89.5 per cent of the No. 19, 120 pair plant, capacity to 91 per cent, and *cost* to 69.5 per cent. This is an attractive showing.

Conduits as now built readily take a 2½-inch diameter cable, and possibly one 2¾-inch, so by existing construction cable sizes are now limited to the preceding dimensions, and design must accommodate itself thereto. In a general way it appears desirable to have about seven varieties of cable for subscribers' lines, and about three varieties for toll and trunk-line service. Table No. IV. gives the approximate general properties suggested.

TABLE IV.—CABLE DATA.

Purpose	No. Pairs	Size of wire	Capacity per mile
Subscribers lines distributing cable	10	19	.090
Subscribers lines distributing cable	30	19	.090
Subscribers lines distributing cable	50	19	.080
Subscribers lines distributing cable	100	19	.080
Subscribers lines distributing cable	200	20	.100
Subscribers lines main cable	300	20	.108
Subscribers lines main cable	400	22	.115
Subscribers lines main cable	600	24	.130
Trunk line cable	75	17	.065
Toll line cable	50	14	.050
Toll line cable	10	10	.035

With the selection outlined it would seem possible to so adjust cable design under all usual circumstances as to attain good service at a minimum cost.

The Use and Advantages of the Alternating Current for Land Telegraphy—V.

BY EDWIN F. NORTHRUP.

IN Fig. 31 G is the single source of alternating current located at station A. R is a differentially wound relay at station A and a is an artificial line. A relay R_1 not differentially wound, is directly in series with the line at station B. The mechanism at station B is run in synchronism with the mechanism at station A. T and T_1 are transmitters which break the line to cut out or reverse a wave, but do not at the same time connect the line to earth. The relay R is balanced as follows: The line is disconnected from earth by the transmitter T_1 and the artificial line a altered until it equals in capacity and resistance the open circuited real line. Though both the artificial and real line are disconnected from earth, considerable current will flow into them. Now, putting the real line to earth at station B, the relay R will vibrate again. The vibration is a consequence of the extra amount of current that enters a line grounded at its end over that which enters a line open circuited at its end. The relay R_1 also vibrates.

If the line is broken by transmitter T at station A, all current is cut off the line and relays R and R_1 both stop vibrating. Hence as a signal consists in causing a receiving relay tongue to momentarily stop vibrating, T_1, can signal to R, and T to R_1 by cutting out half waves. But as the operator at each end of the line stops his own relay vibrating while signaling to the other end, it is necessary to arrange matters so that an operator is never receiving while he is sending or sending while he is receiving.

This matter is easily arranged, at the sacrifice of half the number of simultaneous messages, by arranging the segments on receiving and sending sunflower commutators at each end of the line, as shown in Fig. 23. At station A, the operator sends when the trailer t_2, passes over the 3d and 4th quadrants of his sending commutator, and the operator at station B receives at that time on commutator R^1. When the trailers have gone half a revolution the relations of sending and receiving are just reversed. Further details cannot be here given, but the principle should be clear from the above. The method is not experimental, having operated successfully for months over actual lines about 100 miles long.

By using alternating currents and synchronism for telegraphy, problems of the distribution of telegraphic messages can be worked out that are wholly unsolvable by any of the other known methods of telegraphy.

A discussion of this subject is beyond the scope of the present article. The interested reader must be referred to the United States patents on telegraphy distribution recently granted to H. A. Rowland. He will find described in them matter of great value to the telegraphic art, and the clear solution of numerous cases of complicated telegraphic distribution. What has been so far said in regard to the limits of distance over which lines may be operated duplex or simplex, has had regard to lines where the messages are not relayed or repeated. The Rowland patents describe many methods of relaying alternating-current telegraph lines. In general, automatic relaying can be done as simply as it is now done with the Wheatstone automatic system. Further experience will undoubtedly greatly simplify and extend the methods of relaying and of distributing messages.

I will now describe a concrete case of ordinary Morse telegraphy accomplished with alternating currents. The method is not advocated as being in anywise as valuable as the Rowland printing telegraph. It has, however, the advantage of extreme simplicity and might possibly therefore be tried by a conservative corporation when the far more beautiful, but more elaborate system of printing telegraphy, would not be taken up. The method, with the exception of the synchronism, was worked out recently by the writer. He has not been in a position to give it an actual trial, but his experience with printing telegraphy, which involves a similar class of problems confirms his conviction that it is only a matter of a small amount of experimenting to make perfectly operative this very simple octoplex Morse system of alternating-current telegraphy. In the plan proposed for a system of Morse telegraphy with alternating currents, the chief features are as follows:

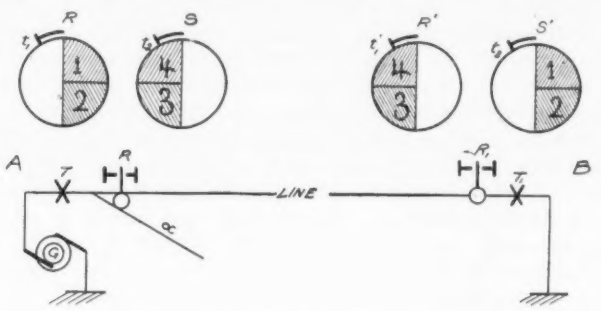


FIG. 31.—"REFLECTED WAVE" SYSTEM OF TELEGRAPHY.

The signals transmitted are the ordinary Morse signals and the transmitting keys are operated in precisely the same way as in the ordinary direct-current system. The signals are received on the ordinary sounders in the usual manner. The lines are multiplexed and duplexed so that at least four operators can be transmitting at each end of the line at the same time. In other words, the capacity of the line is at the very least eight messages at a time. The speed at which each operator can send will depend upon his personal skill, the line having a transmission capacity beyond that of the operators. The multiplexing of the lines is made possible by employing synchronism and the alternating current. The signals are made, at each end of the line, by reversing certain of the alternating-current waves.

We will first describe the manner in which a single operator transmits signals, then how these are received, and we will describe finally how, as a whole, the system works octoplex.

The transmitting of the dots and dashes of the Morse alphabet is accomplished by reversing one half wave of the alternating current for a dot, two half waves for a short dash and four half waves for a long dash, or any multiple of these numbers. But matters are so

arranged that a single operator can only reverse every fourth half wave of the current. Hence the minimum time occupied to send a long dash is equal to at least sixteen half periods of the line current.

Fig. 32 gives the method by which a single operator may reverse the half waves. C is a commutator, shown developed, used as a current reverser, the direct current entering it on the leads, D, D_1, and the alternating current leaving it by the leads a, a_1. The alternating current, developed by the commutator, completes its circuit through the primary of a small transformer T. This transformer has two secondary windings, S_1 and S_2, with their turns wound in opposite directions. They are connected to earth at their middle point m. K is a Morse key hinged at h, and moving between the stops i_1 and i_2. V is a thin steel spring extension from the back end of the key. This spring moves between the poles of an electromagnet M, when the key is depressed. The contacts of the key are made at C_1 and C_2 on the spring. If the spring is against the contact C_1 and current is flowing through the coil k_1, then even if the key K is depressed the contact will not be broken at C_1, because the spring will be attracted down by the magnet and will only bend. But if the key is kept depressed and the current through the coil k_1 ceases, then the spring will move up and contact will be made at C_2. If current now flows through the coil k_2, the contact at C_2 will remain closed even if the key is raised. Thus no sparking of any consequence can ever occur at the contacts C_1 and C_2.

P is a sunflower of 4 segments and t a trailer which revolves around the sunflower at such a speed that the trailer passes over one segment of the sunflower for each alternation of the current produced by the commutator C. The trailer t may be mechanically geared to the shaft turning the commutator C. When the key K is not depressed the alternating current generated in the winding S_1, of the transformer will flow down the line L, going one-fourth of the time by way of the key and into segment No. 1 of the sunflower and the rest of the time by way of the circuit x and into the segments 2, 3 and 4 of the sunflower. Every fourth wave can therefore be controlled or modified by the key, and there will be current on the line at all times. If the key is depressed when the trailer is on segments 2, 3 and 4, the secondary windings S_2 of the transformer is connected to the key by the contact C_2, and as soon as the trailer t reaches segment No. 1 the line will receive current from this winding of the transformer. The current, however, from the winding S_2 is opposite in direction to the current which the winding S_1 furnishes, and hence depressing the key reverses every fourth half wave of the current as long as the key is kept depressed. If the key is kept depressed only long enough to reverse one half wave, a dot will be transmitted, if long enough to reverse two half waves a short dash, and if long enough to reverse four half waves a long dash, or the same will hold for any multiple of these numbers. If by chance an operator should depress the key at the instant that the trailer t is passing over segment No. 1 the reversal of the current would be attempted when the wave was at a maximum and this would cause a spark at C_1. The device, or some similar one, of the electromagnet M, and the spring V would overcome this sparking. In any case the sparking would be small and probably do no harm, so that in practice it is probable that the non-sparking device could be omitted. The device, having been described, will be omitted in the description which will follow of octoplex transmission.

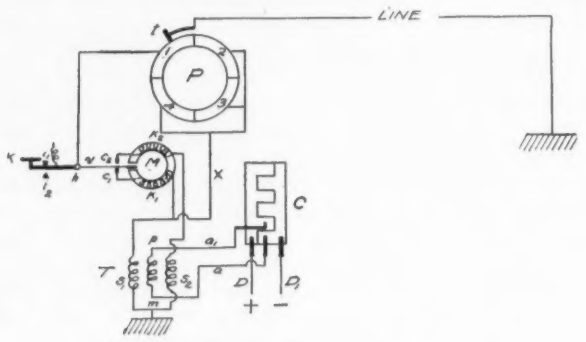


FIG. 32.—METHOD OF REVERSING HALF WAVES.

Fig. 33 gives the method proposed, by which the Morse signals transmitted by a single operator as just shown, may be received. The line current arriving over the line L maintains in vibration the tongues of the polarized differentially wound relay R. The signals which are made by reversing one or more half waves, are received by the relay tongue S_1. The tongue S_2 serves for maintaining the synchronism by any method that may be chosen.

Method No. 3, described on page 822, is a very good one for the purpose. R_1 is a relay which closes its contact k when a wave is reversed. The contact is kept closed for a time, t, to record a dot, 2 t for a short dash, and 4 t for a long dash. The relay performs the same function as one of the relays described on page 822 in connection with Fig. 20. The relay R_1 is, however, connected in the circuits in a different manner than those shown in Fig. 20. The relay R_1 operates as follows: When no half waves are modified the tongues of relay R will always be, for example, against a left-hand

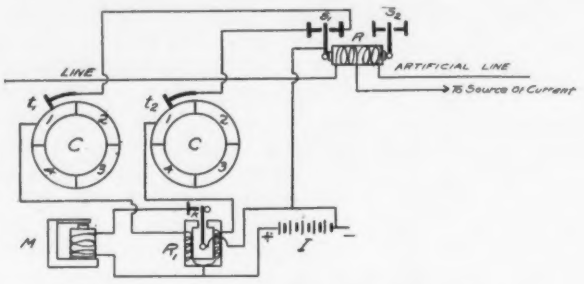


FIG. 33.—METHOD OF RECEIVING MORSE SIGNALS.

contact when the trailers t_1 and t_2 are passing over the odd numbered segments of the commutator C.

In this case whenever the trailer t_2 arrives on segment No. 1 of the commutator, the right-hand coil of relay R_1 will receive current from the current source 1, and the tongue of R_1 will be drawn against its back stop, as forcibly as may be desired. If, however, at the time when the trailers arrive on segment No. 1 a half wave is reversed, the tongues of R will be against their right instead of their left hand contacts. The circuit is completed through the left hand coil of R_1, and the tongue is drawn against the contact k, where it will be left until the trailers again return to segment 1, when the tongue will be returned to its back stop unless another half wave has been modified. As long as half waves continue to be reversed, whenever the trailers arrive on segment No. 1, so long will the tongue of relay R_1 remain against its contaet. Now relay R_1 in closing its contact, k can obviously be made to operate a Morse sounder M, or a tape recorder. The shortest possible time of making a single dot of the Morse alphabet is evidently equal to the time of one revolution of the trailers t_1 and t_2. In general, however, a dot will correspond to two or more revolutions as will be fully shown presently. It is not improbable that the relay R_1 could be so constructed that it would serve in practice for the sounder, in which case the mechanism required for receiving the signals would be somewhat simplified. We will assume for the sake of simplicity in the description to be given of multiplex transmission that this can be done, and that the Morse signals are read by sound directly off the relays connected to the receiving commutator.

Telephones for Freight Trains.

It is stated that freight traffic on Western lines has increased so much of late that it has become very difficult to insure trustworthy means of communication between engine and caboose on long trains. Many of the "double-header" trains hauled daily out of Chicago and Kansas City and other Western points are so long that the rear of the train cannot be seen from the engine when rounding long curves or ascending steep grades. The *Railway Age* tells of some interesting efforts to overcome such obstacles: "The announcement that a western road is to supply conductors with field glasses and a heliograph outfit for use by the head brakeman and the engineer, brings out the suggestion from a Montana paper that while this plan will work on some parts of the line, it will still be necessary to use the long-distance telephone on others, as the trains are so long that the curves shut off the view of the engine from the conductor. The heliograph, it is conceded, may work on the plains, where the vision is not obstructed, except by occasional blizzards, but for mountain sinuosities the trainmen are stated to prefer the far-reaching telephone. Still better, perhaps, might be a narrow-gauge track on top of the train, on which a light trolley car could rapidly convey the train officials in their business trips between rear and front ends."

The Armature Reaction of Alternators—V.

BY C. F. GUILBERT.

EXPERIMENTAL DETERMINATION OF THE VALUES OF F_i AND F_i^1.

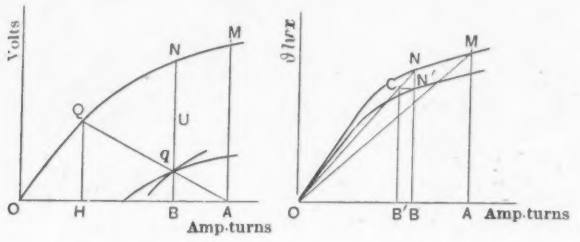
WE can experimentally determine the necessary elements to verify the expressions just given, for the m.m.f's. corresponding to the direct and transverse reaction.

1. Direct Reaction.—Several years ago Blondel published a very simple method for the determination of the e.m.f. corresponding to what it is convenient to call the armature leakage. This method will suffice equally to deduce from experiment the value of the counter ampere-turns. It is merely necessary to introduce a slight correction, which may be dispensed with in some cases, taking account of the influence of the field leakage.

It will be recalled that the method of Blondel simply requires a knowledge of the no-load and short-circuit characteristics established as a function of the field ampere-turns, and of a point corresponding to the machine working on a purely inductive load.

Let *O M N* (Fig. 5) be the no-load characteristic, and suppose the excitation is constant and equal *O A* ampere-turns. If we know the exact value of the armature counter ampere-turns corresponding to the short-circuit current I_{cc} for an excitation *O A*, by laying off these ampere-turns at *A H*, the leakage of e.m.f. of the armature will be represented by *H Q*. This e.m.f. is proportional to the current I_{cc}, and it follows that the angle *Q A H* is independent of the current. If, then, from the point *A* we draw a number of ampere-turns, *A B* corresponding to wattless-current *I* produced by the machine, we will have in *Bq* the e.m.f. corresponding to this current, and therefore in *qN* the difference of potential *U* at the terminals for the excitation *O A* and the wattless output *I*.

The point *q* is, in short, determined by two conditions—its vertical distance from the no-load curve, a distance equal to the voltage



FIGS. 5 AND 6.—NO-LOAD CHARACTERISTICS.

U under load; and its radial distance to the point *A*, which is equal to $a \frac{I}{I_{cc}} \times A\ Q$. This point then comes at the intersection of two curves simple to construct, namely, a curve parallel to the no-load characteristic and drawn at a vertical distance *U* above the first, and a curve from the same characteristic, homothetic with relation to the point *A* and with a homothetic ratio equal to $\frac{I}{I_{cc}}$.

This method implicitly assumes that the right-angle triangle *A Bq* is always a similar triangle, which is only true if there is no magnetic leakage in the field, or if the magnetic reluctance *r* is negligible; in other words, is equal to zero. In fact, returning to formula (21), giving the reduction of flux in the armature for a constant excitation *F* when the machine has an output *I*, the external circuit being completely inductive, we have

$$\phi_i^1 - \phi_i = - \frac{F_i \left(1 + \frac{r}{R_a}\right)}{v \left(r + \frac{R_i R_a}{R_i + R_a}\right)}$$

If we draw (Fig. 6) the no-load characteristic, and if we join *O M*, we know that the tangent of the angle *M D A* is

$$\frac{1}{v \left(r + \frac{R_i R_a}{R_i + R_a}\right)};$$

to obtain the reduction of armature flux, it suffices then to subtract first the m.m.f. *F*, then F^1 and finally $\frac{r}{R_a} F_i$. If we lay-off on *A B*, the value of the armature m.m.f. F_i, *N B* will represent the load flux if there is no field leakage. In reality the effect of leakage is to diminish still further the armature flux by the quantity

$$\frac{\frac{r}{R_a} F_i}{v \left(r + \frac{R_i R_a}{R_i + R_a}\right)}$$ This second reduction being the increase of the field leakage, the flux in the field remains equal to $N\ B \times v$. Stated otherwise, the value *r* introduced in this formula is that which corresponds to the point *N*. To account for the flux corresponding to the effect of leakage, we will then only have to draw from *B* a length $B\ B^1 = \frac{r}{R_a} F_i$. (*r* being the reluctance corresponding to the point *N*); draw a perpendicular from B^1 until it cuts *O N* at *C*; then draw *C N* parallel to *O A*. *B N* then represents the available flux in the armature. To account for influence of leakage by the method of Blondel, it suffices then to substitute for the no-load characteristic *O N M*, the characteristic *O* N^1 M^1, which comes somewhat lower.

In practice, in the case of alternators of slight leakage and with well-made field joints, the ratio rarely exceeds .1; the correction is thus of little interest if the armature ampere-turns are small with relation to the field ampere-turns. This, however, is not the case if the joints are defective magnetically, as, for example, in the case of alternators with laminated poles not machined, or where there is large magnetic leakage; in this case the ratio may attain such a value that the correction must be applied.

As an example, the methods above indicated will be applied to a 760-kw-ampere Heyland alternator made by the Société Electricité et Hydraulique, the dimensions of which were given by the writer in these columns in the issue of March 9, 1901.

For an output of 100 amperes to an entirely inductive circuit, Mr. Heyland found for an excitation of 150 amperes or 7,500 ampere-turns, a terminal voltage of 2,140 volts, the no-load voltage being 2,380 volts. Application of formula (12) gives for $a = b$, $F_i = 0.588 \times 6 \times 141 = 500$ ampere-turns.

The graphical method of Blondel, without the correction above indicated, gives practically the same result, 480. The e.m.f. due to armature dispersion is 160 volts. The transverse armature m.m.f. can be determined experimentally only by having a machine working on a circuit containing a capacity so as to render the current practically in phase with the no-load current, as has been proposed by Blondel. The m.m.f. is deduced then from the right-angle triangle of which the hypothenuse represents the field ampere-turns corresponding at no-load to the load voltage, and one of the sides represents the field ampere-turns during the trial.

This method is only applicable if the fluxes are proportional to the m.m.fs; that is to say, if the magnetic circuits are not saturated. If the armature is not saturated, it can nevertheless be applied, but the right-angle triangle, as will be seen further, should be constructed in this case with the voltages at no-load and at load, and the m.m.fs giving rise to the transverse reaction should be taken from the armature characteristic alone; that is, from the line representing the value of the flux in the armature as a function of the ampere-turns necessary to make this flux pass into the armature (air gap and armature iron).

U. S. Patent Office.

The report of the Commissioner of Patents for the fiscal year ended June 30, 1902, shows that there were received during that year 45,562 applications for mechanical patents, 1,807 applications for designs, 139 applications for reissues, 1,849 caveats, 2,460 applications for trade-marks, 1,020 applications for labels, and 270 applications for prints. There were 27,387 patents granted, including reissues and designs, and 1,864 trade-marks, 750 labels, and 163 prints were registered. The number of patents that expired was 20,335. The number of allowed applications which were, by operation of law, forfeited for non-payment of the final fees was 4,123. The total receipts of the office were $1,491,538.85, the total expenditures were $1,329,924.63, and the surplus of receipts over expenditures—being the amount turned into the treasury—was $161,614.22. The volume of work shown by the commissioner's report is greater than ever before in the history of the office, the total number of applications filed having for the first time exceeded 50,000.

The Latest Telephone Exchange on Manhattan Island.

THE evolution of the modern telephone exchange, as exemplified by the development of the New York system, was illustrated and described in our issue of August 30 last, when all the various styles and types of exchange buildings on Manhattan Island were brought under notice. One exchange was not shown, however, that which is known as "Morningside," and which has but just gone into operation. Even if it were not interesting on its own account, it would be interesting as a proof of the rapid growth of the upper west side of New York city in wealth and population, necessitating an equipment that would be creditable not simply to a new urban section, but as the main office of a city of the first class. In fact, these new branch offices of the New York Telephone Company are becoming so large and numerous, no one exchange has much right to be regarded as the "main central" with leadership. These New York exchanges might in fact be considered as constituting a federation, and they mark sharply the difference between electric light and power work and that of telephony. The sub-stations of a big lighting company are in almost all cases merely the recipients of current from a central point for local distribution, and there the function ends. But while these scattered telephone exchanges are in a sense sub-stations, they are also largely autonomous, and generate and dispose of a very notable amount of business within their own respective territories. Hence, while the central station industry, technically considered, might be spoken of as the highest type of "centralization," the telephone service of New York has been pushed even further to a logical point of decentralization, in order to develop to the highest degree its efficiency in each district it serves.

From time to time, the New York telephone districts have been recast, and the new "Morningside" is an illustration of the process, resulting as it does from the annexation of that part of the Seventy-ninth Street exchange district north of One Hundred and Third Street, west of East River, south of One Hundred and Tenth Street and east of Central Park, to the Harlem district. So far as the comfort and convenience of the citizens are concerned such a change and improvement means far more than any political redistribution, the aim of which is too often gerrymandering and nothing else. In this case but one thought has been controlling, namely, to increase the speed and reliability of the telephone service.

The Morningside office was opened October 18, 1902, at which time 2,914 stations were transferred from the Harlem exchange and 301 stations were transferred from Highbridge. Four hundred and nine stations have been added since the office was opened. The office is located in a four-story building erected for the purpose on a 50 by 100 feet lot, at No. 220 West One Hundred and Twenty-fourth Street. The four floors of this building are arranged and used as follows: The top, or fourth, floor consists of one large room, used as the operating room. This floor is especially designed to have the greatest possible amount of light and air. The ceiling is high and there are windows in the front, rear and one side of the room, and a skylight in the central portion of the ceiling. The room is kept supplied with fresh air by means of a ventilating plant. The floor is covered with rubber tiling, with the idea of reducing the noise in the room to a minimum.

The third floor is devoted to the operators' quarters, and is subdivided as follows: In the rear of the building is the operators'

FIG. 2.—MORNINGSIDE TELEPHONE BUILDING.

sitting room. This is a room 14 by 32 feet, with southern exposure and windows on two sides. It is furnished with easy chairs, and newspapers and current magazines are kept on file for the use of the operators. To this room the operators may retire while not on duty

FIG. 1.—MORNINGSIDE CENTRAL OFFICE.

at the switchboard. Next to the sitting room is located the dining room. This room is 20 by 33 feet, and is furnished with a sufficient number of dining tables and chairs to seat one-third of the operating force. Large steam coffee and tea urns are provided in this room, and coffee, tea and milk are served to the operators free of charge during the lunch periods. Next to the dining room, and with a door opening into the hall, is the locker room. In this room lockers are provided in which the operators leave their hats, coats and lunches while on duty at the switchboard and where they deposit their individual transmitter and receiver sets when they go home. Sufficient locker equipment is provided to furnish one locker for every two operators.

In the front of the building on this floor is located the infirmary. This is a small room, 12 by 16 feet in size, to which the operators are taken in case of sickness. It is furnished with couches and easy chairs, and simple medicines are kept on hand for use in case of emergency. A large toilet room for operators is also provided on this floor. The floors of all the rooms in the operators' quarters, except the toilet room, are covered with linoleum. The toilet room floor is furnished with white tiling. The second floor of the building is one large room, and is used exclusively for terminal room equipment. The first floor is occupied by the Harlem branch of the contract department, until recently located in the Hamilton Bank Building, 215 West 125th Street.

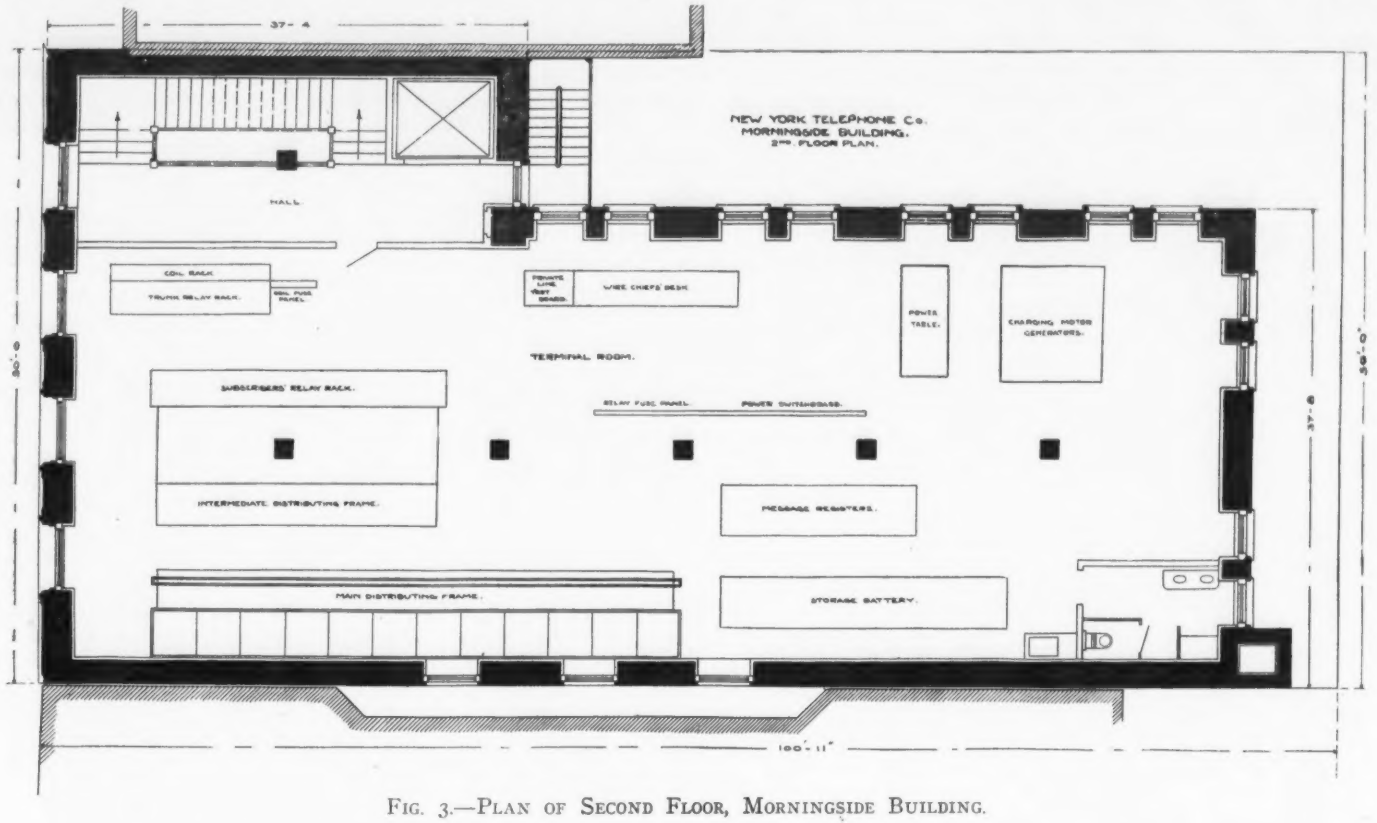


FIG. 3.—PLAN OF SECOND FLOOR, MORNINGSIDE BUILDING.

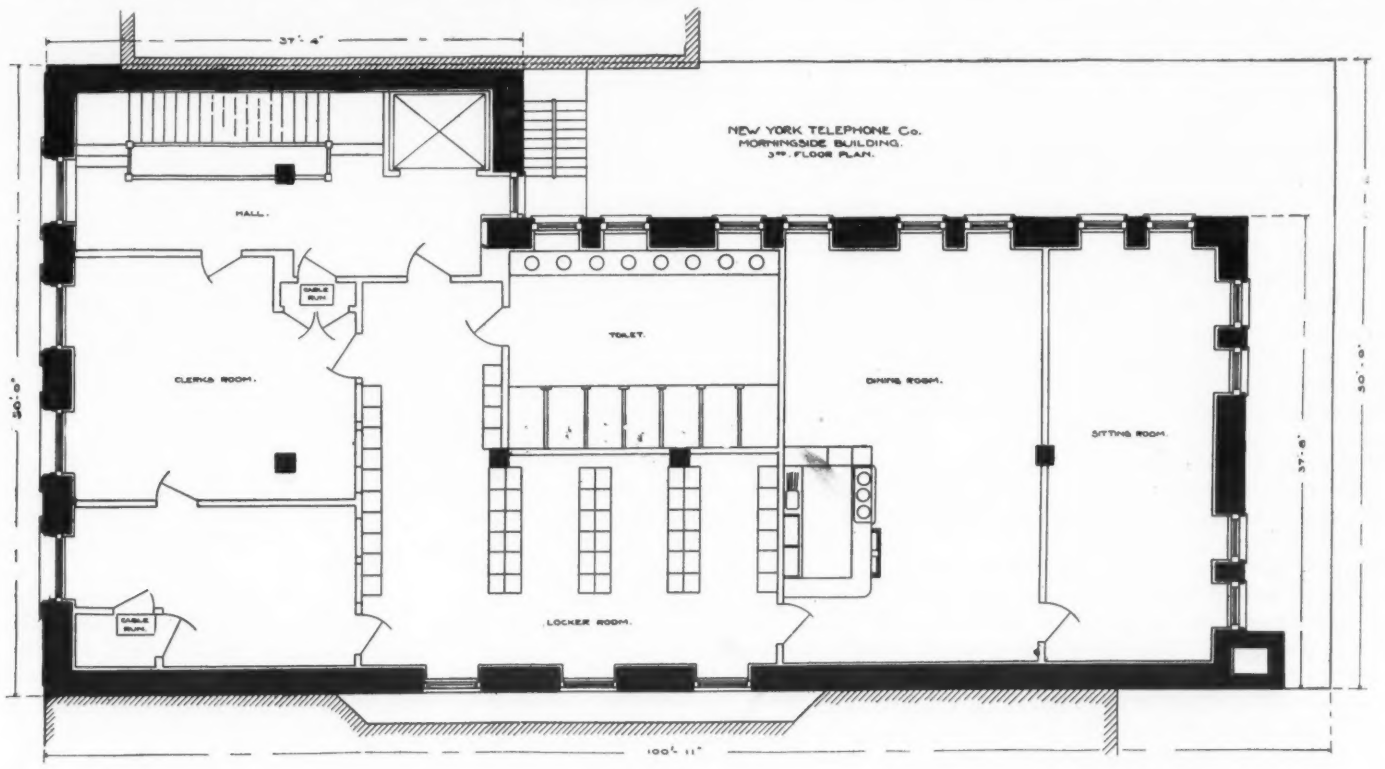


FIG. 4.—PLAN OF THIRD FLOOR, MORNINGSIDE BUILDING.

The following statistics may be given as to the switchboard and subscriber line equipment at this office:

Ultimate capacity of switchboard	7200 lines.
Ultimate no. of operators to be employed	135
Present equipment	4000 lines.
No. of lines transferred from Harlem	1617
No. of lines transferred from Highbridge	261
No. of stations transferred from Harlem	2914
No. of stations transferred from Highbridge	301

Not the least interesting part of the above data is that which refers to the number of lines and stations transferred, for such figures hint at the necessary complexity of a great modern network like that of New York city.

The modern system is a complicated one. The most important factor in the system, the street or signal box, is the least complicated. Its construction is simple, and if carefully made its operation is practically certain. There is a segment of a gear wheel set in mesh with a small geared ratchet, which is arranged to engage the reduction wheel when the segment has been pulled down far enough to give at least one complete revolution of the character wheel. It is impossible to actuate the mechanism without making a complete record of the box number. Most boxes are designed to write the number of the box four times. By an escapement wheel, the box's speed may be adjusted to suit operating conditions. The pulling down of the handle winds up a spring, which furnishes the necessary power to restore the mechanism to its original position, during which operation the character wheel has been revolved several times, opening and closing the electric circuit a number of times, corresponding to the teeth on the character wheel. The teeth are supposed to represent a certain number, which identifies the location of the box. There must be provided in the box a means of sending other signals than the one on the character wheel, and a telegraph key is provided for this purpose. For acknowledgment of special signals sent, a sounder or bell is provided. The contacts of the box are of a delicate nature, and must be protected from an excess of current due to cross contacts with wires of higher voltage by automatically shunting such currents from the parts liable to injury. On overhead circuits there must be lightning arresters. The mechanism must be enclosed in a dust-proof box, with the actuating shaft extended through the case; and this protecting box must be enclosed in still another box, in which is placed the shunting devices, key, signal bell and lightning arresters. An outer protecting box is provided for the entire inner box and mechanism.

A number of boxes are usually placed in a series on a single line. This is called the signal line; and a current is kept constantly flowing through it, save when interrupted by the sending in of an alarm.

In the modern office each signal line, after passing through a suitable terminal board, is brought to a distributing board, where provision has been made for connecting testing instruments, inserting batteries, circuit-protecting devices and means of switching circuits together, finally terminating in a sensitive relay, adjusted to immediately indicate any actual break in the circuit, or even a small decrease in the normal current on the line. Assuming a box has been pulled, the first break of the character wheel allows the armature of the relay at the central office to make an electrical contact, bringing into circuit a bell, an annunciator indicating the

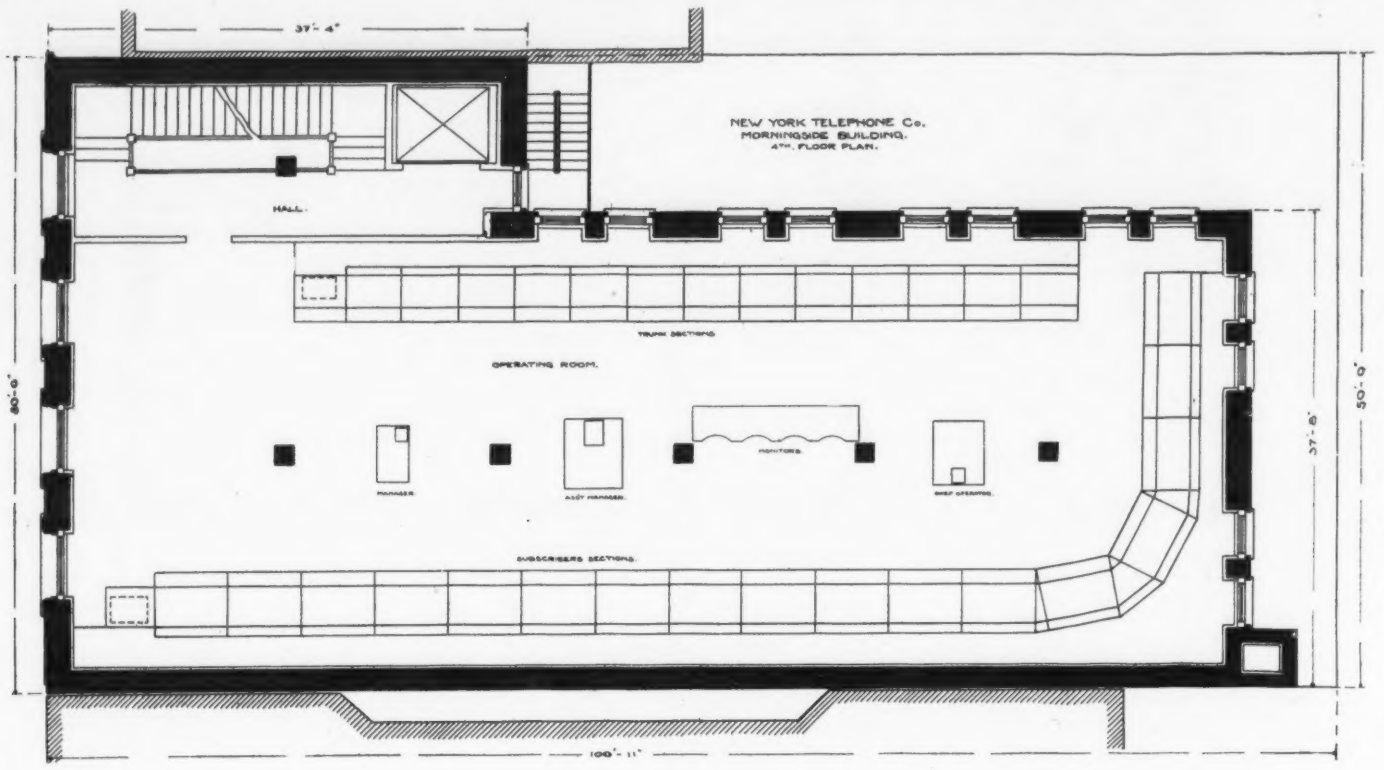


FIG. 5.—PLAN OF FOURTH FLOOR, MORNINGSIDE BUILDING.

The Transmission of Fire Alarms in Chicago.

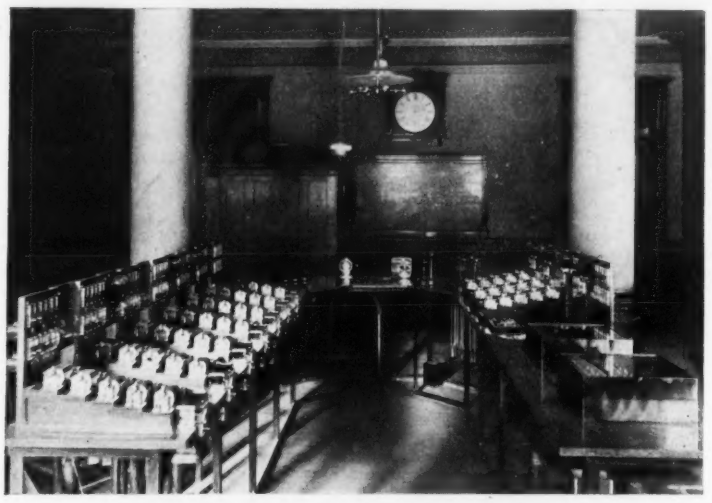
Mr. E. B. Ellicott, city electrician of Chicago, read a paper on the transmission of fire alarms before the Western Society of Engineers the evening of November 19, 1902. As it is well known that Chicago has one of the most complete and modern fire alarm systems in the country, Mr. Ellicott's paper may be reviewed with profit. Without exception, he said, electricity is the agent which has been adopted commercially in the transmission of alarms. The most commonly used system to-day is only an evolution of the first electrically operated system of 1852. Our present mechanically and electrically perfect street box, so simple in construction that a child can operate it, was represented in the earlier days by a box containing a large wheel, upon the periphery of which were teeth representing numbers arranged to make and break the circuit as rapidly as the wheel was turned. If the individual sending in the alarm was excited and turned the wheel rapidly, the reproduction of the numbers was unintelligible. The present boxes are speeded to send the signals which represent numbers at a uniform rate; and when the box mechanism has been once actuated, it will complete its signal without further attention.

Dr. Channing and Moses P. Farmer were the original inventors and patentees of the electric fire alarm telegraph. It would appear that their system was nothing more than an electric circuit provided with several mechanical means of making a series of breaks in the circuit. The breaks in the circuit actuated a bell-striking apparatus. As first applied, the bells were used in connection with the street boxes, but they were also centrally located, and could be heard at considerable distance.

number of the line, and a small incandescent lamp showing both line and individual instrument. This gives two visual and one audible notifications that a break has occurred in the line. These different signals are not dependent upon each other, and the failure of one will not interfere with the operation of the others.

At each relay is located a three-point switch, normally standing on the point to which the alarm bell is connected. If the break in the circuit is identified as a box number, the switch is turned to another point, which brings a printing register into circuit, and a permanent record of the box is obtained. To the second point of this switch a sounder is connected, which is used for general telegraph purposes.

An alarm having been received, it must be sent to each and every engine house, battalion chief's quarters and police stations. Not only must the alarms be transmitted, but they must be automatically registered in each location, and to avoid possible errors or failure of individual instruments, each alarm must be repeated from an entirely different line, with provisions for a second printed record and an additional gong alarm to insure attention. Means must be provided for the engine companies to advise the main office of their return from a fire, and as this is important information, two separate means must be provided for sending it. When a company has returned from a fire, every other engine company must be notified of it. To devise a means of transmitting this information reliably, quickly and without too great an expense in construction and maintenance of lines, has required skill and inventive ability,



CENTRAL FIRE ALARM OFFICE, CHICAGO.

and the problem was solved by Mr. John P. Barrett, former superintendent of city telegraphs.

A circuit is established through a certain number of engine houses and terminates in the main fire alarm office, at which point it is provided with the same switching and testing facilities described for signal lines. The line is supplied with a slowly alternating current. This reversal of current makes possible the use of the line for two separate classes of signals. At each of the engine houses there is placed in the alarm line circuit a polarized relay that responds to each reversal of current in the line, and has connected to its local points a printing register. When the current is reversed a given number of times at the main office, each polarized relay in the circuit responds, closing a local circuit in each engine house, and automatically printing the number of reversals on a paper tape. In this way the number of the street box is simultaneously transmitted to each engine house. These lines are not used for any other purpose than the printing of the box number.

There is another line similarly constructed and operated, except that it performs two functions. In addition to its polarized relay for each engine house, it has a direct-current relay and a telegraph key, by means of which the Morse Code and a special department code is made available for transmitting instructions, certain reports and alarms not requiring the services of more than one engine, and for receiving the reports of engine companies when they return from fires.

The work of the polarized relay in this circuit differs from that performed in that just described, as in addition to printing the number of the box, it actuates a second circuit, in which is placed a large gong, acting as a "waker" for the men. This gong is always in circuit and will always sound unless the attendant on watch switches it out, which he does if the box struck is not responded to by his company. There is also a small table bell in this line which furnishes a second means of reading the alarm in the event of the register failing.

The receiving and sending of an alarm is briefly described as follows: Simultaneously with the pulling of the street box the annunciator on that line at the main office falls, and an alarm bell rings, calling the attention of the operator, who switches the register into the local circuit of the relay and obtains two perfect records of the box number. At each bank of relays there is located a key controlling the pole changers in the circuits running to all engine houses. The operator reproduces the box number twice on each key, using first the key that controls all alarm lines in which there are only polarized relays. This prints two records of the box in each engine house. Immediately after this it is repeated on the key controlling the pole changers in the secondary alarm wires, and two more records of the box are printed in a like manner; and if the attendant at each engine house is not at his post to hold out of service a large gong, it will sound and awaken the men; so that the attendant must be at his post of duty, and is sure to be caught if asleep when an alarm comes in to which his company should not respond.

It would seem from this description that the operation of such system would be slow, and valuable time might be lost; but actual records of alarms received and transmitted show the average time required to receive an alarm from the box and transmit it over the two lines as described requires but twenty-four and one-half seconds, and with short number boxes has been less than fifteen seconds. This speed cannot be obtained with any automatic transmittig or repeating devices in service at the present time, and it is doubtful if any such apparatus will ever reach the state of perfection that will permit it to equal these records.

Electrical Features of the Aurora, Elgin and Chicago Railway.

The largest crowd ever gathered together at a meeting of the Chicago Electrical Association listened to a paper by Howard Brooks on the "Electrical Features of the Aurora, Elgin & Chicago Railway," on the evening of November 21. This road has justly attracted much interest because it represents the highest type of interurban equipment and construction yet to be found.

The rolling stock as described by Mr. Brooks, consists of motor cars equipped with four 125-hp motors, geared for a maximum speed on a level of 65 miles per hour. Current is conducted to the cars by a 100-lb. third rail. The track rails are 80-lb. and the track construction throughout is equal to that of the best steam roads and suited for the highest known speeds. The power is supplied from one generating station at Batavia, from which it is transmitted to sub-stations at 26,000 volts, 3-phase. Each sub-station has step-down transformers and two 500-kw rotary converters. The switching is nearly all done on the 26,000-volt lines by machine-operated oil switches. The only switches in the main low-tension circuits are the starting switches at the rotary converters. Each generator is connected directly to its bank of transformers, and the switches governing the unit are on the high-tension side. Three 1,500-kw units are in the power station. The transmission lines are aluminum mounted on glass insulators, but these insulators are being replaced by porcelain as rapidly as possible, as the particular lot of glass insulators used on this job seem to have been remarkably defective and much trouble has been experienced from burning off of pins and pole tops.

It appeared from the discussion after the paper that the current necessary to maintain the cars at maximum speed with 600 volts at the sub-stations is 400 amperes. Mr. Gonzenbach, electrical engineer of the company, stated in the discussion that while no elaborate tests on the performance of the cars had been made as yet, some rough tests demonstrated that the standard car of the road could be brought up to a speed of 60 miles per hour in 35 seconds with a maximum current of about 1,200 amperes. The integrating wattmeter readings at the sub-stations show a consumption of 123 kw-hours per car-hour. As the cars make about 28 miles per hour this would equal 4.39 kw-hours per car mile.

The Development of the Fort Wayne Telephone Company's Exchange.

FORT WAYNE, Ind., is a live, progressive city of nearly 60,000 people and growing rapidly. It was one of the first cities to enter the field of independent telephony, sixty of its business men forming a company for this purpose in 1895 under the name of The Home Telephone & Telegraph Co., and capitalized for $100,000. Active steps were taken at once to secure a franchise, which was obtained January 14, 1896, upon submitting a list of eight hundred contracts for telephones, stipulating rates of $36 for business and $24 for residence. At this time the Central Union (Bell) Co., which had been operating for over seventeen years had 527 lines in operation. Construction was begun without delay, and in July of that year service was established. Six months later the number of subscribers had been increased to 1,100, and this ratio of growth made it necessary after two years to increase the capital stock to $250,000. Dividends were paid on the stock within one year after beginning operation, and have been paid quarterly ever since. At the present time, the amount of stock issued is only $200,000, and the investment has commanded a higher premium from year to year. The list of subscribers now counts 800 business houses and 1,700 residences, and there is a waiting list of 200. In order to accommodate the new exchange described in this article, ground was purchased in 1901 in the central part of the city and the contract let for a three-story office building of pressed brick and stone, of which the company now occupies the second and third floors. The second floor is given up to the offices, and the third floor is occupied entirely by the operating room and subsidiary plant and apparatus.

The Fort Wayne Home Telephone Company began operation five or six years ago, as noted, installing at that time a magneto transfer trunking switchboard, with something over a thousand subscribers in service. The outside construction work was practically all overhead at that time, and the system was what is known as common return. Provisions made for the future growth of the exchange at Fort Wayne—as in hundreds of other places—were insufficient, and the exchange soon outgrew the estimated number of subscribers, and the allowance in pole, line and switchboard capacities, made in anticipation of the future growth of the exchange. In consequence of the rapid increase of subscribers, a vast amount of reconstruction work was necessary, and many appliances were added to the exchange equipment from time to time, for the purpose of facilitating the work of operation; but all to no purpose. This has been only too common an experience with independent telephone exchanges.

Something over a year ago the Home Telephone Company decided to abandon the out-of-date apparatus then in service, and install a modern up-to-date central energy multiple system. It was deemed best at that time to perform the work of reconstructing the exchange plant gradually, and that this work should follow the installation of the new equipment as rapidly as possible. This decision was arrived at in view of the fact that the exchange had reached a point where it was practically impossible to furnish satisfactory service, and something had to be done. The Home Company awarded the contract for the complete installation of the switchboard and telephones to the Stromberg-Carlson Telephone Mnufacturing Company, and on July 1, 1902, the new exchange was opened for service. Engineers of the Stromberg-Carlson Company asserted that a combination system such as would be required in order to operate a system of full metallic and common return lines jointly, could be successfully installed and operated. Not only were they warranted in this confidence, as we know now with the completion of the work, but the successful manner in which all obstacles have been overcome, the cutting over from the old board to the new, and the replacing of the old style magneto telephones with central energy instruments is highly creditable to those who had the work in charge.

FIG. 2.—EXCHANGE BUILDING, FORT WAYNE TELEPHONE COMPANY.

The present equipment of the switchboard is complete for 2,280 subscriber lines, with an ultimate capacity for 5,600 lines. Of the 2,280 subscriber lines, perhaps some four hundred are full metallic. The others are on common return circuits. The switchboard is equipped for a full metallic lamp line signal bridged multiple central energy system, with eleven sections installed at the present time, with an equipment for 2,280 subscriber lines, 120 lines to each operator's position. (Fig. 1.) In addition to the subscribers' equipment, there are sixty incoming and sixty outgoing trunk lines, with an ultimate capacity for the installation of 240 trunk lines. The circuits employed

FIG. 1.—SWITCHBOARD, FORT WAYNE TELEPHONE COMPANY.

in the equipment of this switchboard and auxiliary apparatus are many of them entirely new, incorporating features for facilitating operation, and producing electrically more satisfactory results. Changes were also necessary in many of the standard circuits, owing to the peculiar conditions surrounding the installation.

The auxiliary apparatus installed consists of three desks-monitor, chief operator and wire chief and a 3-position toll-line switchboard. The desks are constructed of quarter-sawed oak, matching the main switchboard in design and finish. The monitor's desk is equipped with a sufficient number of cord-connecting appliances, exchange line terminals, and terminals for direct wires to the different positions and offices about the building. Each pilot lamp in the main board is also duplicated in the monitor's desk. Capacity for the growth of the exchange is provided for. The chief operator and wire chief's desks are suitably equipped with line terminals, testing appliances and auxiliary apparatus for the present necessities of the exchange, with capacity and arrangement for additional apparatus when required.

The toll-line switchboard is for three positions of the desk type, of quarter-sawed oak, and finished to match the main switchboard. The present equipment consists of twenty toll and party lines—together secondary output of 100 volts, with primary winding for 40 volts with trunking facilities to the main switchboard and branch exchanges. Fig. 3 illustrates the toll board, showing two positions equipped. The toll lines terminating on this board pass through the main switchboard at the toll or "B" position, where they can be handled at night, or at such times as it may be advisable to dispense with the services of the toll-line operators during the quieter hours. The toll position in the main switchboard is equipped with cord connecting appliances arranged for toll to toll service, and also for toll to central energy service.

The power plant, as shown in Fig. 4, consists of two Roth twin motor generator charging sets, motor end wound for a direct current of 500 volts, with an output of 40 amperes from the dynamo, at 60 volts. These machines are provided with the Cutler-Hammer overload and no current release starting box, and a Roth round type field rheostat. Two Roth ringing dynamotors are installed; one a one-half type with primary winding for 500 volts direct current, and a secondary output of 100 volts alternating; the other a one-quarter type ringing dynamotor, with primary winding for 40 volts direct current, and a secondary output of 100 volts alternating. Each machine is equipped with a "Howler," busy-back and periodic ringing attachment; also with the necessary automatic overload no current release starting boxes, copper hand wheel and index plate.

The storage battery plant consists of two sets of 20 cells each of Electric Storage Battery Company's accumulators in lead lined tanks. The batteries are substantially mounted on heavy stringers and foundations.

The main distributing rack, relay frame and intermediate distributing rack, are equipped for 3,000 lines, and arranged for growth in sections of 800. These racks are made of iron of such cross-section

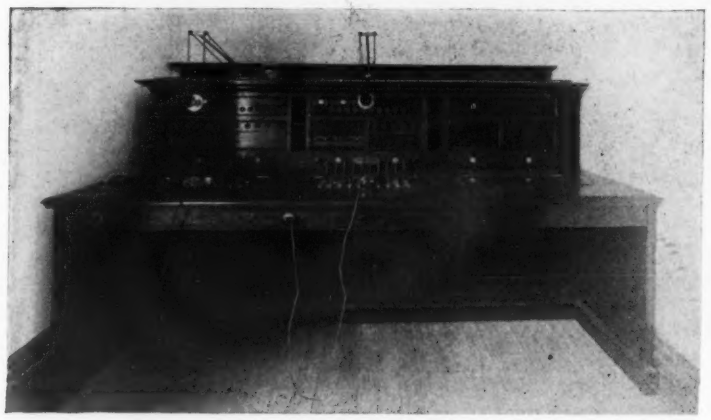


FIG. 3.—TOLL BOARD.

and so braced as to be strong and rigid. On the arrester side of the main rack are mounted the Cook heat coil carbon and mica lightning arresters. The intermediate rack is constructed in the same manner, with arrangement for the rapid handling of wires in cross-connecting, and equipped with a full number of terminals for the 3,000 lines. The relay frame is constructed much in the same manner, but with a view to easy access to all line and cut-off relays employed in the exchange. These relays are mounted in banks of twenty, and are separately inclosed in tubular cases so as to exclude all dust and foreign particles from coming in contact with their working parts.

On top of the relay rack is provided a box, in which is temporarily placed the apparatus made necessary in view of the combination of the two systems, metallic and common return. This box is wired and arranged with a view to its ultimate abandonment, as it is the intention of the Fort Wayne Company to convert gradually their

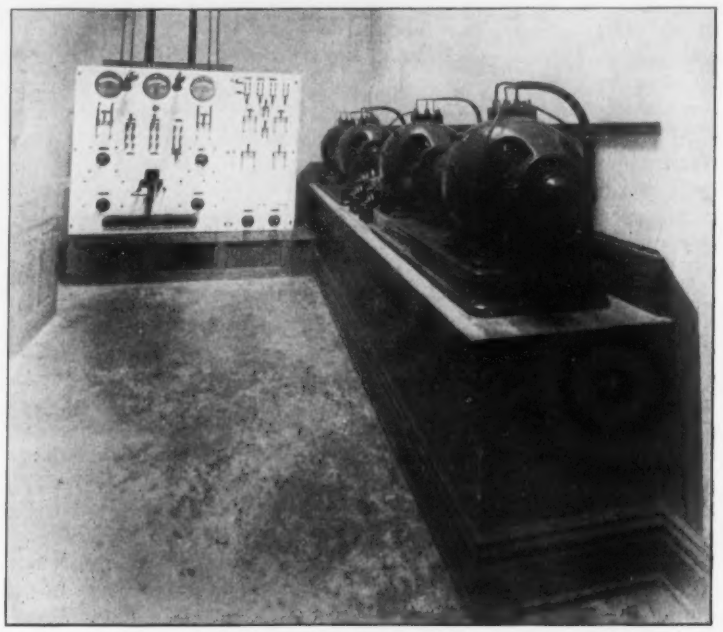


FIG. 4.—POWER PLANT.

system to a full metallic exchange, at which time the box and its extra apparatus, together with the cables, will be removed.

In addition to the main central, the company has a sub exchange about one and a quarter miles from the main, to accommodate a growing part of the city. This was started in 1897, but a new corner site has been purchased for the branch, and after the erection of a new building, a new switchboard and plant will be installed there also. Underground cable is now used throughout the entire business section, and is being constantly extended in all directions. The number of feet of 100 and 200 pair of underground cable approximates 55,000 feet, and there is 65,000 feet of aerial cable.

The officers of the company are: Chas. S. Bash, president; L. C. Hunter, vice-president; Wm. L. Moellering, secretary and general manager; Max B. Fisher, treasurer; and John B. Reuss, Isidor Lehman, G. Max Hofmann, P. W. Smith, W. A. Bohn, directors.

Western Union-Pennsylvania Fight.

The Western Union Telegraph Co. has filed its bill of complaint in its suit against the Pennsylvania. It sets up the right of the telegraph company to continue the possession of its lines on the Pennsylvania right-of-way by reason of its compliance with the laws of Pennsylvania, under which its predecessor company, the Atlantic & Ohio Telegraph Company, acquired its charter, and also under the general act of Congress of July 24, 1866. Western Union claims that it has complied with its requirements under the Pennsylvania incorporation and has also complied with the general intent of the United States act. It claims that the United States act made the Pennsylvania Railway a public highway, and that having complied with all the requirements of law since 1851 it is entitled to remain in possession of its lines so long as it tenders the Pennsylvania the agreed or asked rental. The further claim is made by the telegraph company that it has at all times been willing and now offers the Pennsylvania company suitable compensation for service and that notwithstanding this offer the Pennsylvania proposes to arbitrarily and in violation of law depose the Western Union from its lawful rights in favor of the Postal Telegraph Company. It further sets up in the bill of complaint that there is ample right of way for two companies and that it is not necessary, even if lawful, for the Pennsylvania to depose the Western Union in favor of another corporation.

The Present Development of the Steam Turbine.*

By Edwin Yawger.

THE first Parsons Steam Turbine was built in 1884. It was a 10-hp machine, and ran at a speed of 18,000 r. p. m. The date of this first modern type turbine was only a few years subsequent to the first introduction of the modern type dynamo, and at first thought it would seem that the turbine has fallen far in the rear in the general march of mechanical and electrical progress. A reference, however, to the development of electric apparatus since about 1880 will indicate that the turbine has only recently been provided with a field for the application of its peculiar power producing qualities.

When the first Parsons turbine was produced, the largest dynamos were mere toys compared with the machines of to-day, and a turbine of such small capacity must run at an enormous speed in order to develop its best efficiency. The great preponderance of direct-current apparatus with its difficulties of commutation at high speeds has further checked the application of this high-speed engine in the smaller sizes.

Recent practice in the generation and use of electricity has entirely changed the relation of this prime mover to its application. The rapid growth of alternating-current generation, and the increased size of units has now opened the logical field for the use of this simplest and highest type of prime mover.

The turbine is indeed the simplest of all vapor engines, both mechanically and thermodynamically. The entire rotative effort is produced by the passage of the steam through two simple elements, a nozzle and a moving blade. In the Parsons turbine there may be 20,000 nozzles and 20,000 moving blades, but the function of each pair is precisely alike, and there is no limit except considerations of general design and shop practice to the number of pairs of elements that may be combined in a given turbine. The method by which steam is made to produce the rotary motion of the spindle is by its action and reaction on the thousands of pairs of simple elements. The steam having been admitted through the governing valve enters an annular passage surrounding the revolving spindle. From this passage it enters the first set of nozzles. These nozzles are formed by a large number of curved vanes projecting radially from the cylindrical shell of the turbine. The shape of each nozzle orifice therefore is that of a narrow radial slit. These stationary nozzles or guide vanes deflect the steam to an angle of about 20 degs. from the axis of the spindle. The steam expanding as it passes the orifice then impinges on the first series of moving blades, which are similar to the guide blades, only they are attached radially to the periphery of the rotating spindle.

From the curved moving blades the flow of steam is again deflected back to its original direction, and passes on through the next set of deflecting vanes, which again cause expansion impact and deflection as before. There are anywhere from 20 to 100 of these radial sets of nozzles and blades, according to the conditions of size, steam pressure and vacuum desired. In order to secure the full benefit of the energy of the steam it must, of course, be permitted to expand in doing this work. Each row of nozzles has, therefore, greater discharge area than the one preceding it. This is accomplished by increasing the diameter of the shell and increasing the length of the blades.

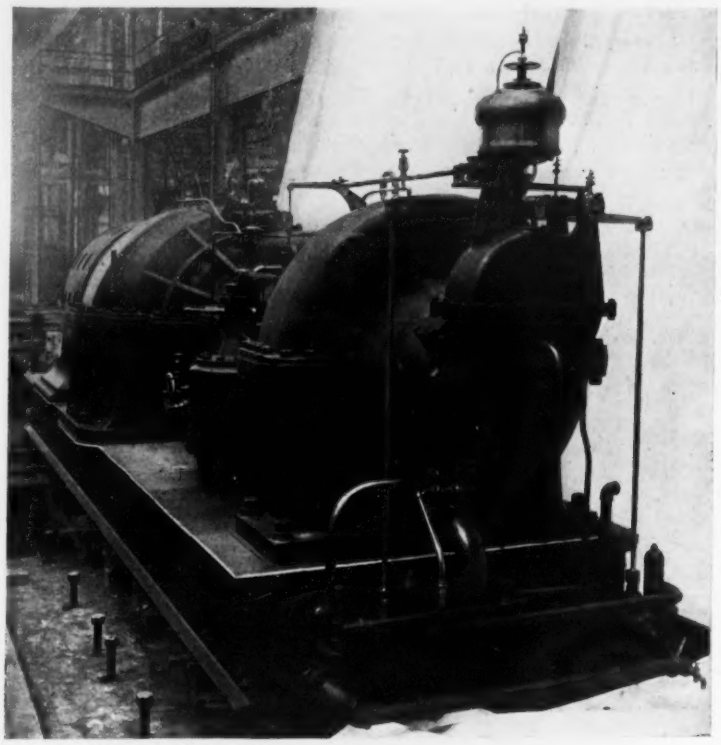


FIG. 2.—1,500-KW TURBO-GENERATOR, TURBINE END.

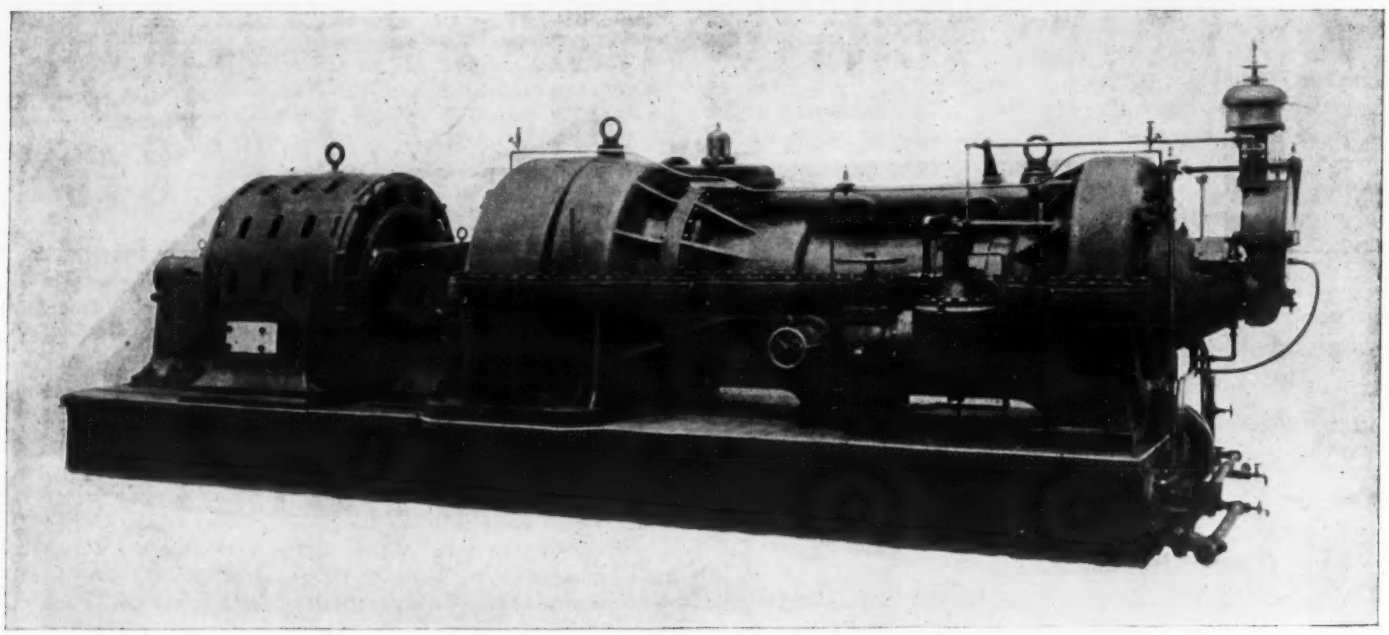


FIG. 1.—1,500-KW TURBO-GENERATOR UNIT.

With a proper arrangement of guides and blades the increase in volume of a unit weight of steam is a measure of the economy of operation.

With initial steam pressure at 150 lbs., and a pressure in the last row of blades of 2 lbs. absolute, we would have the steam expanded to 58 times its original volume. In an ordinary compound condensing steam engine the lowest working pressure

* A paper read at the Columbus meeting of the Ohio Electrical Association.

feasible is about 8 lbs., absolute, thus giving with 150 lbs. initial a final volume of 16 times the initial.

A reciprocating engine might be designed to provide for 58 expansions instead of 16, but in that case the low-pressure cylinder would have to be nearly four times the volume that is

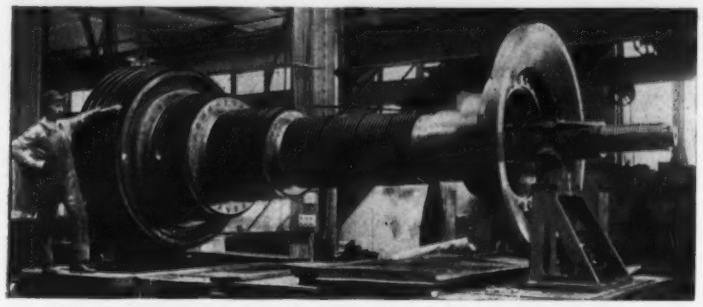


FIG. 3.—REVOLVING PART OF 1,500-KW TURBINE.

given it in ordinary practice, and the friction due to the increased size, together with condensation losses, due to wide difference in temperature between beginning and end of stroke would more than eliminate any gain due to the increased expansion, and the net effect would be to retard the engine with diminishing economy. On the other hand, with the turbines there are no condensation losses, and the addition of a few rows of low-pressure blades to absorb the final energy of steam does not add to the friction of the machine.

It is thus evident that the highest degree of vacuum is of great benefit in turbine practice. It may be added that the turbine is singularly adapted to the use of superheated steam. In addition to the increased efficiency inherently due to superheat, there is a further advantage in the reduction of the fluid friction in the passage of the steam through the blades, and there are none of the attending evils of warping valves and imperfect lubricants.

The exact amount of friction in the turbine cannot be demonstrated owing to the impossibility of securing, by any instruments now available, any equivalent of the indicator diagram. The fact that a turbine without load will continue to revolve for about one-half hour after steam is shut off, indicates how slight must be the friction, especially that of a mechanical nature.

Turning now to the various mechanical details of the machine, next to the essential working parts described above, we would naturally consider, as in other engines, the main bearings to be of the greatest importance. This is emphatically true of the turbine, since a pair of main bearings and a cylinder filled with blades is essentially all that goes to make up such a machine. The duty of these main bearings is much less arduous, however, than that of the bearings of the ordinary engine. There is none of the immense weight of flywheel and reciprocating parts with their attending impact to be upheld and resisted. The turbine bearings support the weight of the revolving spindle only. This spindle, however, at its high speed must revolve about its gravity axis, and this brings in an important function of the main bearing. The gravity axis may differ by, say, .004 of an inch from the geometric axis, and hence it is necessary to introduce that degree of flexibility into the main bearings. This is accomplished by enclosing the bearing shell proper within two or three loose-fitting sleeves, the whole being surrounded with an outer cast iron shell provided with accurate means of adjustment. The bearing and sleeves are lubricated by a forced circulation of oil, and while the shaft is firmly held in place there is no restraint to its revolving with slight eccentricity.

These bearings form the only important rubbing surfaces to be found in the machine, and in case we can prophecy that they will stand up for years against continuous operation, we may consider it a mark of the general durability of the machine. The experience of three or four years in this country and much longer abroad shows that the wear at this point is practically nothing. After a continuous run of 2½ years, 11 hours per day, the bearing of the turbines at the Westinghouse Air Brake Works were examined, and the bearing shells proper were found to be absolutely free from wear, the original tool marks being visible on both the surrounding sleeves and the bearings.

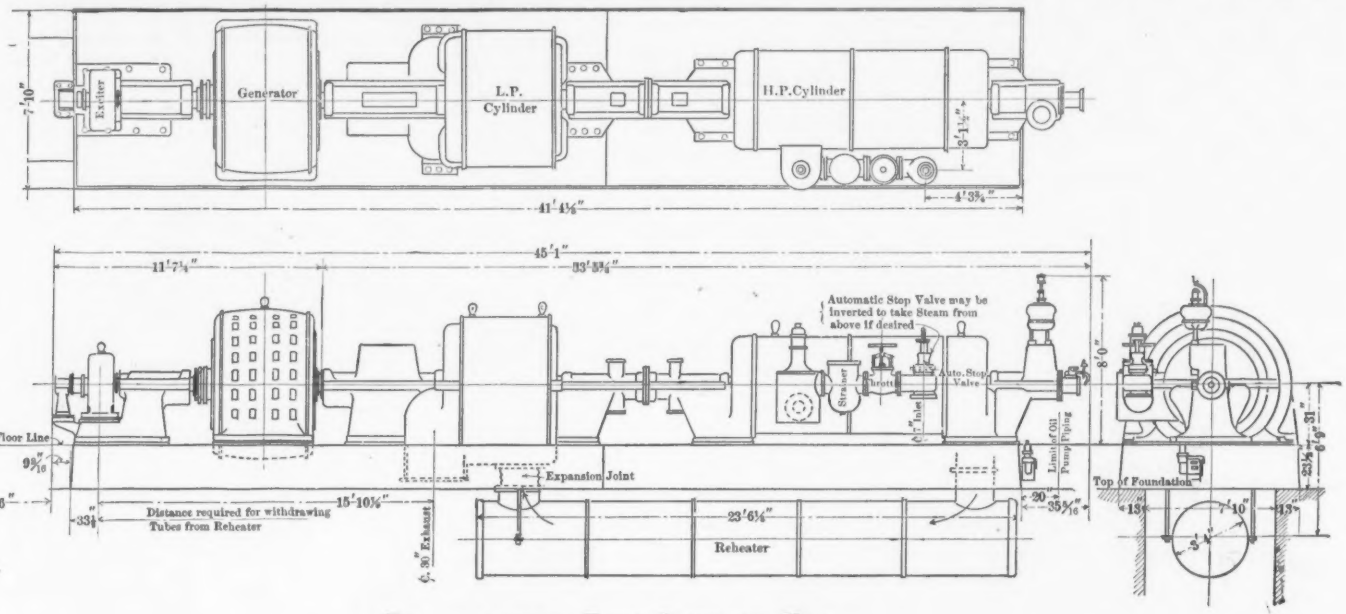


FIG. 5.—1,000-KW TURBO-GENERATOR UNIT.

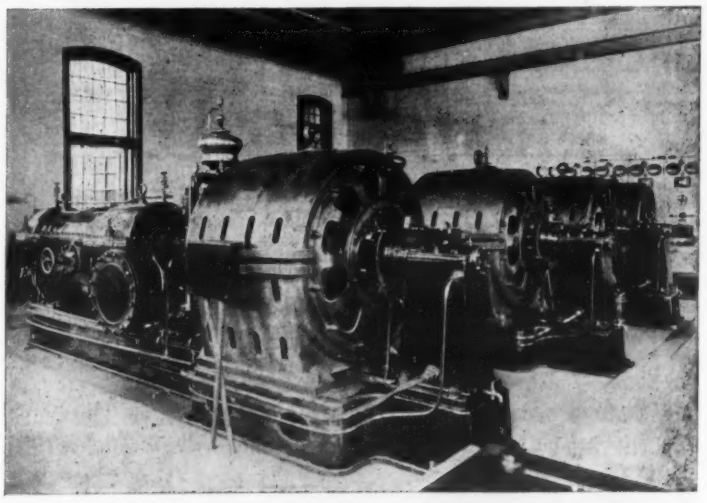


FIG. 4.—POWER INSTALLATION FOUR 400-KW GENERATOR UNITS.

As stated above, the only essential parts of the turbine are a suitable number of nozzles and blades properly mounted and a pair of main bearings. We have only to turn on the steam and

our spindle begins to revolve, blown around by the force of 20,000 steam jets.

It would soon be found that the combined pressure of the blades and spindle in one direction would create a disastrous end thrust. This is treated in the most natural way possible by providing for a balancing pressure in the opposite direction. A disc with equivalent steam pressure mounted on the spindle is all that is required.

On account of the high speed and peculiar eccentricity of the shaft, it is, of course, not possible to use any of the ordinary

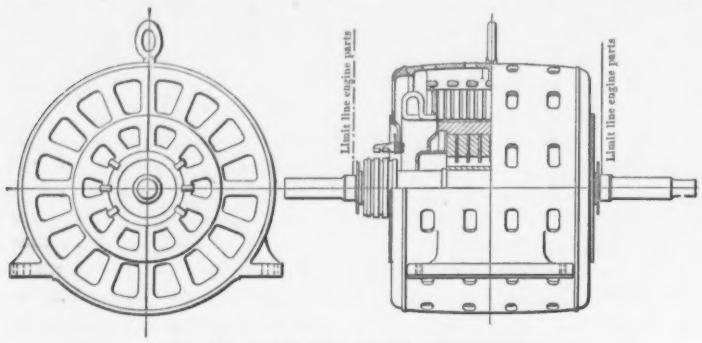


FIG. 6.—1,200-KW TURBO-ALTERNATOR.

gland packing. All glands therefore consist of alternate rings on the shaft and in the shell, which, while not in actual contact, are so close to each other that leakage of steam is prevented.

On a modern reciprocating engine the governor and valve mechanism is considered almost equal in importance to the real working parts of the engine. The eccentrics, rods, bell cranks, links and pins must each and every one be kept up to a perfect state of fit and alignment, else a slight wear in one of the joints will cause the valve to give a faulty steam distribution with its attending pounding, heating, and loss of economy. With the turbine, the governor and admission valve need have only the remotest mechanical connection with the engine itself. In fact, the whole paraphernalia of governing and

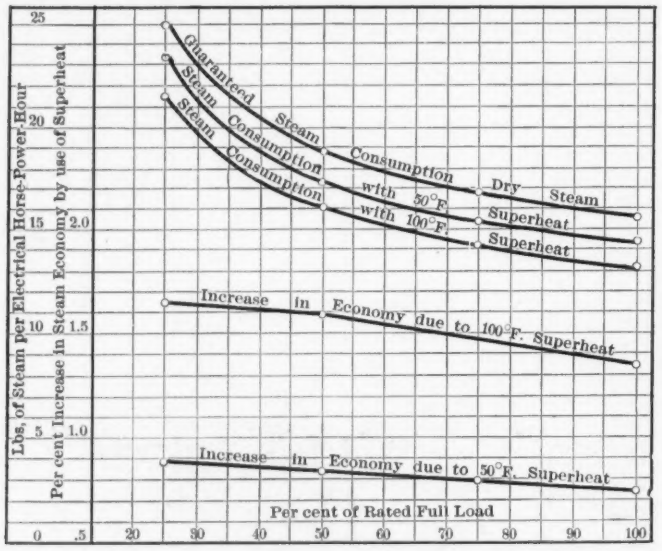


FIG. 7.—APPROXIMATE PERFORMANCE CURVES OF 1,000-KW TANDEM TYPE TURBINE.

admission could be run by an independent motor, or by means of the main generator. The only function of the turbine governor and valve is to let in the right amount of steam. It matters not whether steam is admitted at one precise instant or another, and almost any conceivable amount of wear could take place without interfering seriously with the performance or economy of the turbine. As a matter of fact, the governing mechanism is operated by worm gearing on the main shaft. It is of the fly-ball type, and so designed that the speed will be maintained at any desired uniformity with the further provision that in case of an extraordinary load like a short circuit coming on the machine the governor at once cuts off all steam. Again, should any part of the governor break or for any reason fail to maintain its steady motion, the result would be an immediate shutting off of all steam.

The accessibility of all parts for inspection is almost a novelty in connection with a steam engine. Here it is a case of lifting the cover off and the internal workings are at once exposed.

The accompanying illustrations give two views (Figs. 1 and 2) of a 1,500-kw Westinghouse turbo-generator, and a view of the revolving part of the same (Fig. 3). Fig. 4 shows four 400-kw turbo-generator units, and Fig. 5 represents in line drawing a 1,000-kw unit, the generator being represented to larger scale in Fig. 6. Fig. 7 gives approximate performance curves of a 1,000-kw turbine, showing effect of superheat on turbine economy.

New Southern Bell Exchange at Richmond.

A new exchange building has lately been put in operation at Richmond, Va., by the Southern Bell Telephone & Telegraph Company. It stands on Grace Street, between Seventh and Eighth. It is 40 by 84 feet in plan, and is three stories high, with full basement. The front is of gray pressed brick with terra cotta and Bedford stone trimmings, and is surmounted by a heavy copper cornice. The building is of slow-burning mill construction. All lathing, studding and furring is of metal; the sash and window frames are of metal, and the sashes are glazed with ribbed wired glass. In modern telephone work it is realized that continuity of service is a prime element

RICHMOND, VA., TELEPHONE EXCHANGE.

of efficiency and satisfaction and that in particular the fire hazard has to be dealt with circumspectly, to ensure that no peril of the kind striking in from without shall be able to paralyze the system.

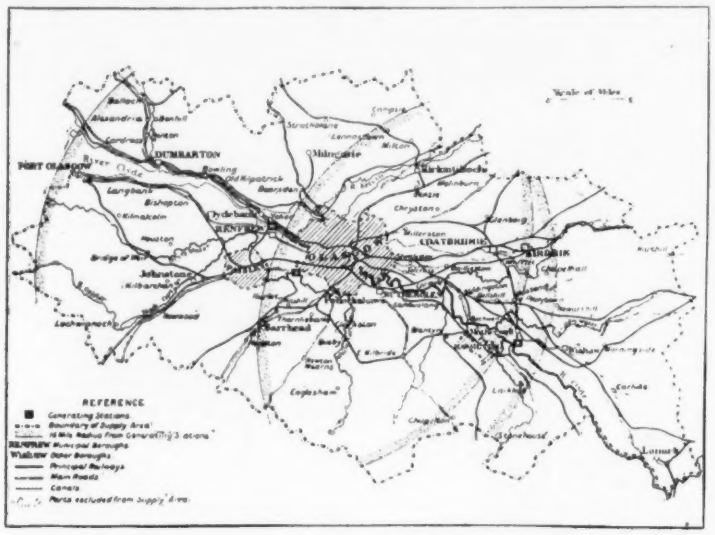
The basement of the building contains the cable vault, the linemen's quarters, and the store room. The first floor is divided longitudinally by a hall, the offices on one side of which are used by the district superintendent. On the other side of the hall are the business offices of the local exchange. On the second floor are located the terminal room, the power plant, storage batteries and inspectors' quarters. The third floor is devoted to the operating room, with the operators' retiring room immediately adjacent. The common battery switchboard has an ultimate capacity of 7,200 lines, the racks, frames and terminals being designed of corresponding size. Mr. E. H. Bangs is the electrical engineer of the company, to whom we are indebted for data.

A Large Power Distribution Enterprise for Scotland.

A bill has recently been sanctioned by Parliament which gives authority for an extensive power distribution scheme contemplating the supplying of power to the industrial region of the lower Clyde River in Scotland. The district covered by the bill includes that part of the Clyde Valley extending about ten miles on each side of the river and about twenty miles up and down stream from Glasgow. The area covered is about 700 square miles, and three generating stations will be erected to meet the demand for power. The scheme has been promoted by a group of manufacturers who desire to obtain cheap electrical power and who realize that this can be better done by joining in a common system than by each putting down his own generating plant.

This is the busiest part of industrial Scotland and contains about 1,200 works, many of which are large iron and steel works, coal mines, shipbuilding yards, and chemical works. Some of these works will alone require more power than many of the local municipalities now provide for lighting purposes, and it was easily shown that it would be inadvisable for the separate boroughs to attempt to supply an amount of power involving so large an expenditure of capital.

The three generating stations are to be built at Motherwell, Yoker and Crookston. The Motherwell station is located in the neighborhood of a large number of manufacturing works and in the center of an extensive coal field and can be connected with the adjoining line of the Caledonia Railway. It is, also, in close proximity to the River



MAP OF GLASGOW AND VICINITY, SHOWING LOCATION OF POWER STATIONS.

Clyde, from which water for steam and condensing purposes can be obtained.

The Yoker station is also situated on the Clyde, near the line of the Lanarkshire and Dumbartonshire Railway, and is in close proximity to a large number of shipbuilding yards, works and docks. Authority has been obtained to lay cables across the Clyde from Yoker to Renfrew, which will enable the works at Renfrew, and other works on the south side of the river, to be supplied from this station.

The third generating station will be situated near Crookston on the Glasgow & Southwestern Railway Canal line; but, owing to the arrangement allowing the company to cross the river, it will not be necessary to construct this station immediately.

The works from which the most urgent demands for power have been received are situated in the areas immediately surrounding the first two sites, and it is intended, therefore, to proceed with these stations first and to install in each a plant of about 4,500 kw capacity. They will be so designed that they can be enlarged from time to time, as the demand requires. A radius of 14 miles from these stations covers practically the whole district in which the company will be allowed to distribute their power, but a large proportion of the works are located within a radius of 6 or 7 miles of the stations. When the stations are in operation, they will probably be coupled together electrically, enabling them to share the loads and average up their power factors or to supplement or aid each other in any emergency. The capacities of the respective stations will ultimately be about 10,000 kw each at Motherwell and Yoker, and 5,000 at Crookston. By utilizing cheap sites for the stations outside of towns and near to the coal mines, it will be possible to generate power at a very low cost. Of the 710 square miles covered by the scheme, only 13 are at present supplied with electricity. It is said that over 300 manufacturers petitioned in favor of the proposition and it is thought that many of the remainder petitioned in favor of the rival Caledonian scheme which was turned down.

The authorized capital of the Clyde Valley Electrical Power Company is $4,500,000, with borrowing powers of $1,500,000. The total cost for plant on the transmission lines is estimated at over $2,000,000. The electrical apparatus, which will comprise polyphase alternating-current generators and transformers for high-voltage power distribution, rotary converters for the supplying of direct current, etc., has been contracted for with the British Westinghouse Electric & Manufacturing Company. Messrs. Strain & Robertson are the engineers of the Clyde Valley Electrical Power Company. Mr. Robert Robertson has recently spent a considerable period in the United States investigating our systems and methods of power transmission and distribution, particularly in our large cities and in such localities as Niagara, Snoqualmie Falls, Wash., Canyon Ferry, Mont., and other places.

Lease of the Manhattan Elevated System.

The general introduction of electricity on the Manhattan Elevated system of New York City and its effect in increasing traffic while reducing operating expenses is seen in the official announcement, issued last week, that the Interborough Rapid Transit Company will lease the Manhattan on a basis of a 7 per cent. dividend guarantee of the latter company's stock by the former. The lease was authorized at meetings of the boards of directors of both companies, the general proposition for such action being approved by both boards of directors. The details of the lease are to be worked out by the officers, under advice of counsel, and the completed document will be submitted for approval to the directors and to the stockholders. The lease will take effect on April 1, 1903, and will be for 999 years. It will cover all the franchises and property of the Manhattan Railway Company. The rental from April 1, 1903, to January 1, 1906, will be the net earnings of the Manhattan Company, not exceeding 7 per cent. After January 1, 1906, the rental will be 7 per cent. per annum on the stock of the Manhattan Railway Company guaranteed by the Interborough Rapid Transit Company. The Manhattan Railway Company stock is to be increased at once to $55,200,000, for the purpose of completing improvements already planned; the present stockholders of the Manhattan Railway Company to have the privilege of taking the new stock pro rata at par.

Provision is to be made in the lease for the ultimate increase of Manhattan stock to the total amount of $60,000,000, including outstanding stock, and due provision is to be made for the application of the proceeds of the sale of the increased stock to the further improvement of the Manhattan property.

The Interborough Company was incorporated May 6, 1902, with an authorized capital of $35,000,000. Under its incorporation it acquired the stock of the Rapid Transit Subway Construction Company. The contract with the city calls for the construction of the rapid transit tunnel for $35,000,000 and its lease to the Interborough for 50 years from date of completion with an option of renewal for 25 years longer. The stock is held in a voting trust. The directors are: William H. Baldwin, Jr., M. F. Plant, August Belmont, Andrew Freedman, James Jourdan, J. B. McDonald, W. G. Oakman, John Pierce, Geo. W. Young, Wm. A. Read, Cornelius Vanderbilt, New York; E. P. Byran, Yonkers, and Gardiner M. Lane, Boston.

The only indebtedness ahead of the common stock is the payment of 3½ per cent. to the city on its contract of $35,000,000 with the city. A sinking fund of 1 per cent. is authorized to commence five years after the road is in operation.

The Interborough Company will pay $10,000 per annum to keep up the organization of the Manhattan Company, in addition to the dividend rental which shall be paid to the stockholders, and the Manhattan stock will be stamped with a contract of the Interborough Company to this effect. The lease will provide security satisfactory to the Manhattan Company for the payment of the dividend rental.

The present capital stock of the Manhattan Railway Company is $48,000,000 and the increase of $7,200,000 to $55,200,000, therefore, represents an increase of about 16 per cent. Investors estimated that the rights to subscribe would be worth about 7. The bonded indebtedness of the company amounts to $39,883,000.

Telephony in the London Fire Alarm Service.

In connection with the improvement of the fire alarm telegraph system in New York City, the question has been raised as to a more

FIG. 1.—METHOD OF BREAKING GLASS.

extended use of the telephone in that department of public utility. The devices herewith illustrated show the system patented and introduced by Commander Wells, chief of the Metropolitan Fire

FIG. 2.—FIRE ALARM TELEPHONE IN USE.

brigade of London. In case of desiring to send in an alarm, the passerby or person running to the street box shown in Fig. 1, breaks the glass, of the alarm post, and the safest way as well as the most convenient of getting at the bell is that of smashing the glass by a lunge of the elbow. The instructions written on the indicator inside are to pull and let go. The alarm bell is sounded simultaneously at the nearest fire station and the brigade is at the same time notified of the location of the fire by the dropping of an armature plate bearing the name of the street in which the fire alarm post is situated.

On arriving at the alarm post, the fireman gives a succession of short pressures to the button until the bell ceases to respond correctly each time. He then brings out his microphone transmitter, inserts the plug or "jacks in," the talking circuit is completed and communication by word of mouth is fully established, the nature of the fire is explained, and orders are given. It is said that the system works quite satisfactorily.

New Telephone Patents.

Of the two telephone patents issued November 25, one relates to the application of the telephone or telegraph to moving trains, while the other covers a new form of selective signal apparatus for party line use. It seems doubtful if either of these inventions has been tried in practical use, for several points in each are somewhat dubious from the practical standpoint.

Of course, the greatest difficulty in applying the telephone and telegraph to moving trains is that of maintaining a sufficiently permanent contact between the stationary wire and the moving contact on the train, and it is this difficulty which the inventor has attempted to overcome by the use of an electrolytic contact cushion. Fig. 1 shows two views of the apparatus. Referring to the sectional view,

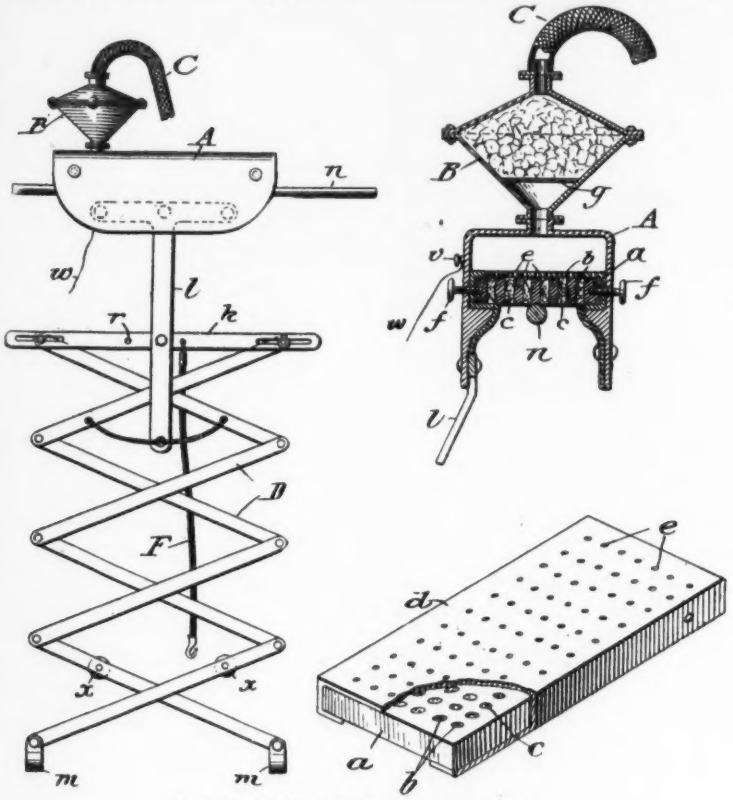


FIG. 1.—JONES TRAVELING CONTACT.

A is a perforated absorbent pad encased in a suitable envelope, another view of which is given underneath. The apertures of the pad are filled with fibrous material such as cotton batting, and the whole pad is carried in a metallic holder, as shown. Upon the top of the metallic holder a receptacle *B* is mounted, filled with salt, saltpeter or the like, and supplied with steam from the locomotive engine through a suitable flexible hose. When steam passes through the salt and becomes condensed, the solution falls upon the pad and keeps it continually moistened with conductive fluid. As shown in the elevation, the holder and pad are to be mounted upon a lazy tongs, which the inventor states is to be attached to the cab of the locomotive under the control of the engineer, who may manipulate the contact to and from the wire by the handles *xx*. A conducting wire is extended from the holder to the cab, and a cord of elastic material is provided to make a springy connection between the pad and locomotive.

While the principle of an electrolytic contact may be all right, it seems certain that with a train traveling at reasonable speed, the arrangement under discussion would fail, for every time a splice in the wire was reached there would at least be some jar which would open the circuit. Furthermore, it is doubtful if anyone could manipulate the contact successfully by the handles *xx*, for a very slight movement of them would mean a considerable movement of the contact, and one can readily imagine the amount of "fishing" engineers would have to do to catch his wire. The patent for this device bears the number 714,189 and is issued to A. I. Jones.

"Telephone switch" is the title of the patent for the selective system, referred to above, granted to Mr. John A. Warrick, of Sheldon,

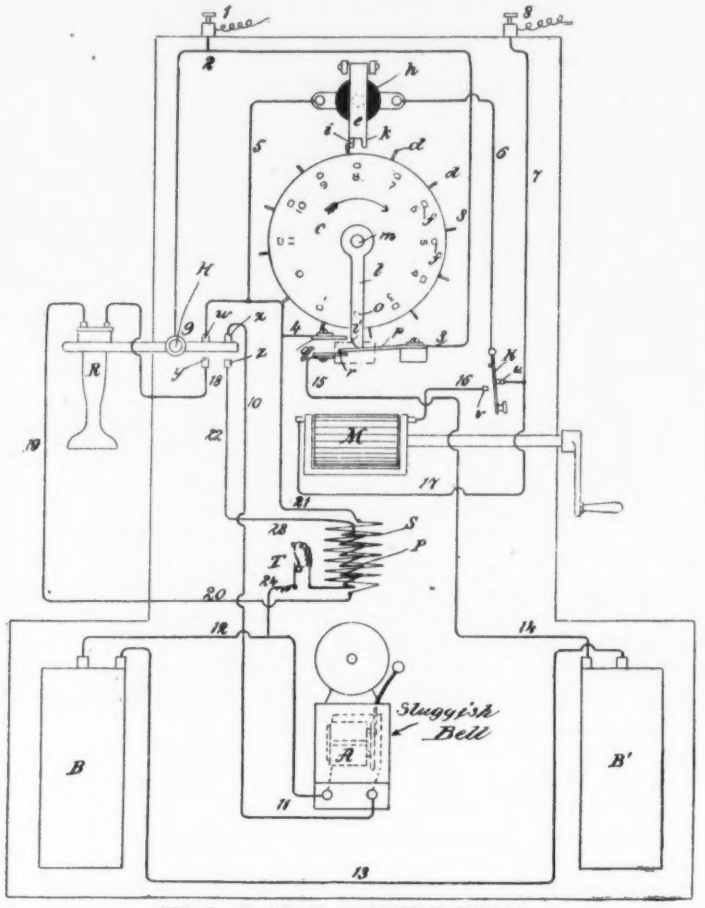


FIG. 2.—WARRICK TELEPHONE SWITCH.

Ill. The system as described depends upon spring motors for its action, one of these motors being located at each subscriber's station. At each station there is also located a desk *C*, shown in Fig. 2. This desk is geared to the spring motor and is controlled by the electromagnet and pallet, shown respectively at *H* and *E*. Mounted above the desk and upon the same shaft is the arm *L*, adapted to revolve with the desk when its boss *O* engages one of the notches *F* of the desk, and also adapted to be turned manually when brought into such a position as to clear the notches *F*. Overhanging the edge of the disc is a stop (not shown in the drawing), beneath which is a key adapted to be so operated by the point of the revolving arm as shown, that it breaks one contact and makes a second. Normally, at each station the arm *L* must be kept engaging that notch of the disc which bears a number corresponding to that of the station.

Now if station No. 2 desires No. 4, the subscriber at 2 moves his revolving arm to his notch 4 and then by means of the direct-current hand generator *M* and the push button *K*, he sends four impulses out on the line and advances all disks and revolving arms four positions; the switches beneath the stops at stations 2 and 4 will then be operated. The switches will not be operated at this time at any other station, for by hypothesis the arm at each of these was a different number of teeth away from its stop than 4. The bell at the selected station rings automatically. When the conversation is completed, No. 2 must, by supplying further impulses to the line, bring all the disks to the zero position, and he must also restore his arm to notch 2, or else he cannot be called except with No. 4, in which case he will not be desired.

The system has a very novel lock-out feature by which if a station tries to break in on a conversation, he cannot do so, for the act cuts off the talking parties. This condition is due to the arrangement of the stop, which clears the face of the disk just sufficient to allow of the passage of the arm when this latter is close to the disk, its boss engaging a notch of the disk. It is therefore only possible to affect the switch of an instrument by electrical impulses thrown upon the line. If the interfering station sends out such impulses, the arms of the talking station 2 and 4 will be moved away from their switches, thus breaking their connections to the line and cutting them off. Furthermore, if any one attempts to make a call when the line is busy, there being no busy test and no way of listening in, a similar cutting off of the existing conversation occurs. This, together with the probability of the subscribers forgetting to wind their machines and also forgetting to reset their arms after conversation, seem to limit the practical use of the system.

Testing the Niagara Power Tunnel.

While the first six units in the new station of the Niagara Falls Power Company will probably be in operation within the next three months, the complete installation of the new wheel-pit will not be in operation until the end of next year. For this reason the company seized an opportunity that presented itself on November 19 to test the full capacity of the tunnel in the development of power. The tunnel was built to carry off the water from turbines having an output capacity of 100,000 hp, and while the company has never doubted that capacity, it felt there would be no harm done in testing the question.

The necessary amount of water was obtained by the operation of the 10 units in wheel-pit No. 1, three new units in station No. 2, and then flowing enough water through the next three penstocks and wheelcases to make the amount equal to what would be used in the development of 100,000 hp. The tests began at 10 o'clock in the morning and were not finished until 5 in the afternoon. While the tests were being made, none of the tenants of the Niagara Falls Power Company had their supply cut off, and there was no interruption in the service except in the case of the mill of the International Paper Company, which was entirely shut down for less than an hour so that the discharge from the turbines, giving 8,000 hp, might not be observed in connection with the discharge from the two wheel-pits. It will be remembered that the wheel-pit of the International Paper Company discharges into the main tunnel through a lateral tunnel. When the installation in the Power Company's two pits and the paper mill pit were all in operation, the tunnel carried off the water in a satisfactory manner, and the tests were announced to be a success. There can be no doubt about the tunnel being able to perform the work for which it was constructed.

An interesting spectacle was developed on the lower river by the tremendous volume of water that was discharged from the portal of the tunnel during the tests. This discharge extended way across the lower river to the Canadian side, a portion of the surface current going up stream and a portion down stream. Close observation of the effect of the rush of water at the portal showed there was considerable space between the top of the arch of the portal and the water; in fact, practically the entire semi-circular arch remained above the water level.

Naturally, the engineers of the company took great interest in the test and the corps was well represented. Among those present was Clemens Herschel, of New York, the consulting hydraulic engineer of the company. Of the directors, Edward A. Wickes and Victor Morawetz were present, as was also William B. Rankine, first vice-president of the company.

Ocean Wireless Telegraphy.

A cable dispatch from London of November 29 says: The *St. James Gazette* says that it has the best authority for saying that the Marconi Wireless Telegraph Company has received no news from the inventor, confirming the statement of Mr. Henniker Heaton, M. P., that a Marconi message would soon reach King Edward from Lord Minto, Governor-General of Canada, as a preliminary to the inauguration of a service across the Atlantic. Lord Minto will probably be asked to open such a service, but the station at

Cape Breton is not yet completed. The Marconi company is not prepared at the present time to indicate the probable date when it will be ready, but it is fully expected that a service will be in operation before 1903. A new magnetic detector is now being tested with a view of increasing the speed of transmission. It is answering the purpose admirably. With the ordinary coherer, the guaranteed speed is only ten words a minute, although twenty words have been sent. According to the inventor, the magnetic detector will enable him to send forty words a minute with comparative ease, and he thinks there will be little difficulty in increasing it to sixty words a minute.

In a special from Glace Bay, Cape Breton, the *New York World* quotes Mr. Marconi as saying: "I do not think our system will be a serious rival to either ocean or land telegraphy. I would say that it would eventually become an auxiliary to it and that the successful transaction of business over the sea will tend to stimulate cable business under the sea. It is possible that our system being cheaper may militate to some extent against the other, though I do not think it will to any great degree."

Social Intercourse by Telephone.

In a recent article on social conditions in the Middle West, Mr. Booth Tarkington in *Harper's Magazine* remarks on the manner in which the long-distance telephone is "kept ringing across these Central States" as a means of maintaining social intercourse. A writer in the *New York Sun* develops the theme in regard to social affairs generally. One reason why the art of letter writing is dying out, he says, is that the telephone is being used more than ever as a means of communication between friends in the matter of invitations, for the announcement of important events and for the sending of messages of congratulation and condolence. Those who cling to the old forms seem to be in the minority to-day. The younger generation refuses to be hampered by the time-consuming methods of several years ago, when a note of invitation, for instance, could not even be sent through the mail, but must be delivered by hand. The modern youth or maiden picks up the telephone and dispatches an invitation to luncheon or the matinee, and even for so serious a function as a dinner it is quite common now for a hostess to call up a friend at the last moment, frankly admitting by the action that she only desires to fill some place that has been left vacant at the last moment. In fact, there is a fad for telephoning messages of this sort nowadays. When it first gained entrance to residences the telephone was intended as a means of communication between a man's office and his home chiefly; then it began to be used for the ordering of cabs, for marketing, for hurrying up slow tradesmen and the various uses connected with housekeeping.

By degrees friends began to make use of the quick method of communicating with each other, and it was so delightfully informal that it became a vogue. Of course, old-fashioned persons regarded with horror the idea of transmitting messages of a social nature in this way; but the age is in such a hurry that the time-saving method has grown to be accepted as quite the proper thing. The informality of the telephone method of communication is what appeals to the younger generation of society. An invitation given or accepted or rejected in this way has not the importance attached to the old method of a note delivered by a messenger. This was a serious affair, and one pondered over the answer to send, the extent of the social obligation involved and other matters. But this message over the wire is different. One does not have time to study questions as to motives, dress, the people one is to meet or any other of the small problems that frequently arise on the reception of a formal invitation. The telephone bidding reeks of the up-to-date. It simply states that the occasion is there waiting, and it calls for a quick decision. There is no reading between the lines and no time to ask why and wherefore. It lacks the chilling dignity and importance that sometimes linger quite unintentionally about a note.

The telephone used as a means of communication between friends must be used carefully, and for this reason in every fashionable woman's sitting-room where her desk telephone may rest, there is a book of record upon which calls sent and received are jotted down.

Calling has also been affected through the use of the telephone. Women are much too busy nowadays with their many affairs to spend time at the old game of paying calls.

CURRENT NEWS AND NOTES.

RAILROAD UP MONT BLANC.—The Geneva correspondent of *The Daily Chronicle* announces that plans have been submitted for the construction of an electric railroad to the summit of Mont Blanc from the village of Les Houches on the Savoy side of the mountain.

DETECTIVE TELEPHONE TAPPING.—It is stated from Stockholm, Sweden, that the creditors of a business man who had serious doubts of his integrity employed a detective to obtain information about him. The detective "tapped" the telephone wire of the house at which the suspect was living and overheard enough conversations to make out a case against the man. It would be interesting to know whether this breach of privacy was effected with the connivance of the telephone authorities.

JIM CROW CARS.—A telegram from New Orleans, of November 8, says: A large number of affidavits were sworn to-day against President Pearson and the other officials of the New Orleans Railways Company, resulting from their failure to place screens or partitions in the trolley cars to separate the white and negro races. The law was passed last July, and the company was allowed 120 days in which to arrange the screens. The law is bearing harshly on the whites, owing to the inadequate number of cars that are being operated during the rush hours.

COMPOSITE ARC LAMP CARBON.—A patent issued November 25 to Prof. A. Blondel, of Paris, France, describes a composite carbon for arc lamps consisting of three concentric parts, namely, of an outer coating of non-scorifiable carbon, an intermediate body of carbon combined with coloring or light-producing salts, and a core of carbon combined with alkaline salts, which may also include coloring or light-producing salts. The body is formed of a paste containing about equal quantities of fluoride or phosphate of calcium, and the coating is formed of pure carbon. The core is made of the alkaline salts used ordinarily in the manufacture of low-voltage and cored carbons, such as tartrates, carbonates, etc., of sodium or potassium, etc.

THE AMERICAN MACHINIST has just celebrated the twenty-fifth anniversary of its existence by issuing a very interesting and very handsome souvenir extra number to celebrate the event. It has become a custom amongst technical and trade journals thus to set up milestones along their pathway and the custom is well justified in the case of publications that are representative of the arts and industries for which they speak. No journal can better claim to have aided and fostered the industries and arts with which it is associated than the *American Machinist*, which always and especially of late years, has been a vigorous and brilliant exponent of progressive tool construction, the development of more perfect machinery, and the advocate of what may best be termed American ideas in the mechanical arts. Of all this the memorial number is a worthy and lasting record, of which its editors and publishers may well feel proud.

NEW ENGLISH SUBMARINE.—A cable dispatch from London of November 29 says: Submarine boat A1, the joint invention of Vickers Sons & Maxim and the Admiralty, was tested in deep sea experiments in the Irish Sea on Tuesday. A heavy sea was running and there was a thick mist. The boat was quickly submerged and traveled several miles, not returning to the surface for some hours. A depth of from ten to fifteen feet was obtained. Manœuvres in and out the flag marks were gone through with, the vessel answering her rudder with great rapidity in whichever direction it was desired to go. She was brought promptly to the surface on several occasions and was submerged with equal rapidity. The surface trials were then run and the speed showed considerable improvement. It is believed that the new boats which are now being built will be more formidable than any with which trials have been made by foreign powers. The A1 returned to Barrow after dark. It is believed she will be fitted with a new petrol engine for the purpose of charging her storage batteries and propelling her on the surface with greater speed than has hitherto been obtained.

THE PENNSYLVANIA-WESTERN UNION FIGHT.—It is announced that the Pennsylvania Railroad Company has agreed to tolerate the presence of the Western Union Telegraph Company's poles and wires on its property until the suit to remove them is determined. The case will now be heard on its merits.

ST. LOUIS EXPOSITION.—Mr. Charles J. Sutter, of St. Louis, secretary of the Electrical Contractors' Association of the State of Missouri, has written the St. Louis Exposition management: "In reference to the meeting of the National Electrical Contractors' Association in St. Louis in the year 1904, I beg to state that, although we had at the previous meeting in Buffalo secured the 1903 meeting for St. Louis and the Detroit delegation were out for the 1904 convention, we succeeded in having the St. Louis meeting postponed to 1904."

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS.—A meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers was held at Canton, Ohio, on November 15. At the afternoon session a paper was read on "High-Tension Electrical Transmission of Power," by T. W. Shelton, mechanical engineer of the Northern Ohio Traction Company. A banquet was given in the evening, after which two papers on mechanical subjects were read. Mr. Elmer E. Miller was re-elected president. The next meeting will be held in February at Warren, Ohio.

SEARCHLIGHTS AS TARGETS.—Gun practice at balloons is not a recent idea, but it is stated that aiming at searchlights is a new refinement of range finding. An interesting experiment in night artillery work was made in Germany recently. A searchlight was placed at a distance unknown to the officers in command of a field battery, and after it was turned on, the guns were brought into action against it. Six 4.7 guns were used, the range was obtained very rapidly, and within five minutes the light was broken to pieces. Another searchlight, at a range of about 2,200 yards, was broken after a few rounds had been fired.

RAILROAD SIGNALING.—After the fatal railroad accident at Offenbach the German government took up the matter of a means of prevention of similar accidents, and a large number of propositions submitted have been examined. One of these is a system invented by Hubert Pfirmann, of Frankfort, which has recently undergone a successful test on a line of railroad between Sachsenhausen and Goldstein. In this system there is an insulated rail between the wheel rails. A sliding contact maintains connection between this rail and the engine, and rheostats are arranged in such a manner along the line that at a certain distance the approach of an engine on the same track is signaled by a red light. By means of the third line the engine driver is able to communicate by telephone to the other train and to give the necessary warnings and instructions.

ELECTRIC RAILWAY SYSTEM.—A patent granted November 25 to M. T. A. Kubierschky, of Berlin, Germany, relates to a system of restoring to the line the energy of retardation of electric railway cars, the method permitting of the location of the necessary means along the line of the railway instead of on the vehicle. Extending from either side of a railway station is an auxiliary trolley line connected with a storage battery, of which there is one for each station. In each battery station there are two switching devices, one for trains from each direction. The main trolley conductor is divided into sections corresponding to the several stations. When a car approaches a station, connection by trolley is made with the auxiliary conductor, whereupon a motor-switching device at the station reduces the tension on the main trolley line by cutting out battery cells; the car controller in the meantime having been turned to the braking notch, the car motors are separately excited, and the current they generate passes into the battery circuit.

COMMERCIAL PACIFIC CABLE.—President Roosevelt signed last week the agreement between the United States and the Pacific Cable Company, and Honolulu will be in direct communication with this country before January 1. The cable ship Silvertown, carrying 2,200 miles of cable for the link between San Francisco and Honolulu, will begin laying the line on December 4. The shore ends have been made ready to the water's edge, and communication can be established as soon as the marine portion is laid. The landing in the United States will be at a point south of the Golden Gate, whence an underground conduit will carry the cable to the Postal Telegraph Company's Building in Market Street, San Francisco. The Hawaiian landing will be on the island of Oahu, and direct connection will be established with Honolulu. A site has already been secured in Honolulu and an office is now being prepared. The contract signed by the President specifies that the entire line from San Francisco to the coast of China shall be completed within one year from the beginning of work, but the cable officials assert that it probably will be completed much earlier.

CABLE MONEY TRANSFERS.—The announcement that the last instalment of money for the completion of the shipping combination, which is to be closed next Monday, was transferred from here to London this week by purchase of cable transfers, has started some inquiries, says the New York *Evening Post,* in regard to the exact nature of this form of remittance The process is simple enough, owing to the use of cable messages sent in cipher code. For instance, a New York house having heavy payments to make on the other side, applies to the local agent or correspondent of a London banking firm for what is known as a "cable transfer" covering the amount desired. If the rate quoted for the transfer is satisfactory, the New York house pays the local correspondent of the London bankers the equivalent (in dollars) of the sum to be paid in pounds sterling at London. To this is added, of course, the cost of exchange and transmission. The bankers effecting the transfer then cable their London branch (in terms known only to the London house and its New York agent) asking that the specified sum be paid immediately to such and such a firm. This is done the same day out of funds that the New York agent or correspondent has actually on deposit in London. The whole thing can be done within a few minutes, including the transmission of the advice by cable, whereas if demand bills were bought it would require a week before the transaction could be completed, since the bills have to be sent by mail. Rates for cable transfers rule generally from ½ to 5/8 cents higher than the price of sight drafts. The system is properly safe-guarded, so that mistakes are virtually impossible.

COOLING RAILWAY MOTORS.—A method of cooling railway motors with compressed air is the subject of two patents granted November 25 to C. O. Mailloux and W. C. Gotshall. The source of compressed air used for the motor-cooling system may be either that which serves for the air-brake system or a different source, but the preferred arrangement is to use the same source of compressed air for both the air-brake and cooling systems The air is conveyed through suitable pipes having flexible couplings leading into the motor case, the air being distributed inside the motor frame between the field coils, by means of perforated pipes or other equivalent distributing device. The control of the cooling air supplied to the motor may be effected in either or all of three distinct ways. The exhaust vents of the present air-brake system may be made to return the air through an exhaust pipe in such manner that the air from the air brake cylinders, instead of being exhausted into the outer air when the brakes are released, is sent through the cooling pipes into the motor cases. The second method consists in the use of automatic devices, whereby air is periodically allowed to flow for a determinate period of time from the air storage cylinders into the cooling pipes. The third method consists in the use of thermostatic devices whereby air will be allowed to flow from the air storage tanks into the cooling pipes whenever a certain limiting temperature is reached. It is claimed that the introduction of such means of artificial cooling will enable the size and the consequent cost of a motor equipment required for a given high-speed service to be materially reduced, and that in cases where a given motor equipment has reached its limitations, owing to excessive heating, the motor output may be materially increased, so as to enable the rate of acceleration and the number of accelerations in a given time, to be both increased, thereby enabling a much higher schedule speed to be attained than would be possible without such means of artificial cooling. The use of artificial means of motor cooling would also permit the introduction of methods of electric braking in many cases where such methods would not now be permissible, owing to the fact that the motors are already overworked, and that the attempt to use the motors as generators in braking would heat them beyond the temperature limits allowable.

NOBEL PRIZE AWARDS.—According to London advices, Nobel prizes have been awarded as follows: Physics, Dr. Arrhenius, of the Stockholm High School; Natural Science and Chemistry, Dr. Emil Fischer, of the Berlin University; Medicine, Dr. Finsen. The Nobel research prize was awarded to Major Donald Ross, of the Liverpool School of Tropical Medicine in recognition of his investigations into the mosquito-malaria theory. Five prizes are, in accordance with the conditions of Alfred Nobel's bequest, awarded to those persons who have contributed most materially to benefit mankind during the year immediately preceding. The amount of each prize is $41,600.

FOUR-WIRE, THREE-PHASE DISTRIBUTION.—With the ordinary star-connected transformer, if a fourth or neutral wire is added to the distributing circuits, no single circuit can be used alone for the reason that there is no corresponding circuit through the primary of the transformers. In a patent issued November 18 to John S. Peck, this deficiency is overcome by providing each transformer with two secondary windings of substantially the same length, which are interconnected so that the current at any given instant through the two secondaries of each transformer will be, with reference to the neutral, in opposite directions.

PARALLELING ALTERNATORS.—In synchronizing direct-connected alternating-current generators having a different number of poles, when one machine comes up to synchronism it is usually the case that another is not in synchronism. A patent granted November 11 to Frank H. Jeannin describes a means of synchronizing under these conditions without the use of synchronizing indicating devices. The machines are connected directly to the circuit in starting up, and to prevent the flow of excessive cross-currents under this condition, the machines are connected in circuit through compensators or tension-reducing devices until synchronism is attained, when the compensators are cut out of circuit. The compensators are merely step-down transformers, with a small winding.

PICTURE TELEGRAPHY.—A patent granted November 11 to Herbert R. Palmer describes improvements relating to that system of picture telegraphy in which the details of the copy to be transmitted are represented by insulating surfaces. The picture is first photographed on a half-tone plate with the use of a mesh so coarse that when etched the picture is represented by depressions in the plate of varying widths of considerable size. These depressions are then filled in with an insulating compound, the plate then being used for transmitting. The picture received is reduced by photography, thereby bringing the dots close enough to give the proper appearance to the eye. This method of transmitting pictures was fully described and illustrated in ELECTRICAL WORLD AND ENGINEER, April 13, 1901.

RECORDING ELECTRIC WAVE FORMS.—An electrochemical method of recording electric wave forms is the subject of a patent issued November 11 to Edwin J. Murphy. A paper saturated with a chemical easily decomposed by an electric current—such as an aqueous solution of iodide and bromide of potassium containing starch or dextrine—is caused to pass rapidly between an upper and a lower row of styles. The styles are connected to opposite points of one side of a Wheatstone bridge arrangement in circuit with the varying e.m.f. to be measured. In every half cycle each pair of styles will be at neutral potential and at this point no trace will be made on the paper. The final record will consist of a white curved line on a colored closely lined surface. One of the advantages of this system is that it is unaccompanied by distortion from inertia of moving mechanical parts.

REGULATION OF ALTERNATORS.—A patent issued November 25 to Harold W. Buck describes a means of regulating dynamo-electric machines, and particularly of alternators, whereby variations from a normal voltage acts to modify the field strength. In case of an alternator a rheostat in the alternator field circuit is operated by a motor having a differential winding, one element of which is in circuit with a storage battery and the other with the direct-current side of a small rotary transformer, the alternating current side being connected across the alternator mains. At normal voltage the e.m.fs of the battery and converter balance and the motor remains at rest. In case of variation above or below the normal, the excess or decrease of converter e.m.f. cause the motor to revolve in one direction or the other, thereby causing resistance to be cut in or out of the alternator field.

SUPPRESSION OF "HUNTING."—The suppression of "hunting" of rotary converters is the subject of a patent granted November 11 to Edgar W. Mix, the means consisting in a certain disposition of the brushes on the direct-current side. Instead of providing commutator brushes and arranging them on the commutator in the usual manner, so as to extend over a number of segments just sufficient to secure sparkless commutation, the brushes are staggered, or, in other words, arranged with one or more brushes in advance of the neutral line and others behind the neutral line. The brushes are electrically connected together by circuits of high conductivity, thereby producing local short circuits in the armature conductors connected respectively to the segments within the extreme limits of that portion of the commutator which is spanned by the brushes. The induced currents set up in these local short circuits act to oppose the causes which produce them, and thus act to prevent variations in the speed of the machine.

ELECTRICITY IN THE ARMY.—Notwithstanding the increasing part electricity plays in modern warfare, the only cognizance which it receives as a study at army training posts is at the Signal Corps station, at Fort Myer. Moreover, in the army reorganization scheme of Secretary Root, which is put forward as representing the most progressive thought, this factor is entirely neglected in the section on training. Commenting on the omission of electricity from the curriculum of the general service and staff college at Fort Leavenworth, the *Army and Navy Journal* says: "Secretary Root has gained for himself the highest praise for his generous plan of military training and education, and it is only natural that there should be some defects and omissions in the scheme which will become apparent and will be corrected when the system gets into working order. The subject of field communication is one of the greatest importance in military operations. It has become a vital part in controlling the operation of troops, especially in time of war. It is a factor in military strategy quite as important in its way as are good marksmanship and efficient armament in theirs. For that reason it seems singular that an important matter of this kind should have been overlooked, but the omission will undoubtedly be supplied without the material delay which would impair the efficiency of the system of education at Leavenworth. As a matter of course, it can not be permanently ignored since it bears such a close relation to the success of armies in the field. It should certainly be a part of the education of officers who have to do with the management of troops in the field and who should be fully acquainted with the subject of electricity so far as it pertains to their duties in time of war."

LETTER TO THE EDITORS.

The Effect of Electrical Waves on the Human Brain.

To the Editors of Electrical World and Engineer:

SIRS: In a letter answering our criticism of Mr. Collins's work on the above subject, which appeared in your issue of May 31, that gentleman objected to the validity of the results we obtained, on the gound of our not using precisely similar apparatus to his own; and advised us to make a further series of experiments with apparatus of a similar nature to that employed by him, without, however, informing us to what extent he found the brain to act as a coherer.

Purely to satisfy our own minds, we followed Mr. Collins's advice and went through, in a systematic manner, all the experiments detailed by him in his first article of February 22, using, however, in addition a milliammeter to test and corroborate the results obtained with the telephone receiver. For a minute and accurate description of our apparatus, we beg to refer the enquirer to Mr. Collins's original article. We may say, however, that Mr. Collins did not specify the metal of which his contact points were made; ours were invariably of platinum.

The results—verified by three observers—were even more definite and conclusive than those obtained with our large apparatus, and

were negative in every case; this, although the resistance in our last coherers dropped from 30,000-40,000 ohms to between 10 and 15 ohms. Consequently, we fell justified in asserting that the maximum amount of cohering phenomena exhibited by the brain, must be less than one-tenth of one per cent.

These experiments were made simply for our own satisfaction, and our results obtained before we were aware of the publication of Mr. Collins's letter in your issue of October 11. If Mr. Collins will be good enough to reread his last letter he will see that the tone he has adopted of mere alternate affirmation and denial—without advancing fresh proof or reasons for either—renders it as useless as it is impossible for us to further answer him.

Should Mr. Collins, however, wish to continue the discussion on scientific rather than on personal lines, we shall be happy to meet any fresh experimental or theoretical evidence of the correctness of his contentions and the consequent inaccuracy of ours.

D. McINTOSH.
J. GRAHAM-WILLMORE.

MONTREAL, CANADA.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Commutation.—PRENZLIN.—A very long theoretical article on sparkless commutation in direct-current dynamos with carbon brushes for running the machine in opposite directions and with the brushes fixed in the neutral line. With the aid of diagrams, the author discusses at length the conditions of sparkless commutation and reaches the following conclusions which are said to have proved to be correct in machines designed for the General Electric Company, of Berlin. The e.m.f. induced by self-induction and by mutual inductions in the commutating coils, for which a formula is given, should not be more than 1.5 volt; his equation shows that this e.m.f. is small if few windings are used per coil; for multipolar machines with several windings per armature coil a series winding is the best. High-speed machines must have great speed of the circumference in order not to make the armature breadth too great. High saturation of the teeth is of advantage. The ratio of the induced current to the supply current at the end of the commutation, for which a formula is given, should never be greater than 0.7. The e.m.f., induced by self-induction and by mutual induction in the commutating coils, multiplies by the ratio of the induced current to the supply current at the end of the commutation, should not be greater than 2 volts. The e.m.f. which is induced in the short-circuited coils due to the movement in the magnetic flux produced by the magnet poles and the armature ampere windings, should not be more than 2 volts. The current density representing the ratio of the total supply current to the total brush section of the poles of equal signs, should not be greater than 5 to 6 amperes per sq. cm. The current density at the end of a brush leaving a commutator bar, due to both the supply current and the induced current, should not be greater than 20 amperes per sq. cm. No resistances, like nickeline bands, should be inserted between the winding and commutator. The General Electric Company, of Berlin, now makes motors up to 50 hp and more for fixed position of the brushes with rotation in either directions.—*Elek. Zeit.*, October 23, 30.

REFERENCES.

General Transformer.—EICHBERG.—An illustrated article on the diagrams representing the action in the "general transformer."—*Zeit. f. Elek.*, October 5.

Brush Holder.—An illustrated description of a brush holder devised by Gand. It is for a radial brush and contains a clamp for easily replacing the carbon brush.—*L'Ind. Elec.*, October 25.

LIGHTS AND LIGHTING.

REFERENCE.

Nernst Lamp.—An article on the gradual development of the Nernst Lamp, with a portrait of Nernst.—*Elec. Rev.*, November 15.

POWER.

Power Transmission in India.—An illustrated article on the power transmission from the Cauvery Falls to the Kolar gold fields. The distance from the power house to the nearest motors attached to the line is 92 miles; after reaching the gold fields the length of the distributing systems places the farthest motor considerably over 100 miles from the source of power. The increase in output in the gold fields, due to the introduction of electric power, is in certain cases as high as 15 per cent. The power when delivered at the gold fields is used for two main purposes, for crushing gold quartz and for the driving of the air compressors which work the compressed-air mining tools below the surface; there is a continuous load for practically the whole of the 24 hours. The motors now installed vary in horse power from 5 to 400, and the average output is over 130 hp per motor. As a rule, induction motors are used, but some of the larger ones are of the synchronous type, which enables the lag of the current in the line to be adjusted. Four thousand hp have been contracted for to cover a period of the next 10 years. The turbines were furnished by a Swiss Company, and the whole electric plant by the General Electric Company of this country. Three-phase currents are generated at 2,200 volts and transmitted at 30,000 volts. At the transformer station at the gold fields the voltage is reduced to 2,300, which is the distributing pressure employed. A further reduction to 220 volts is made wherever small motors are to be supplied, but every motor taking 100 hp or more is wound for 2,300 volts. The loss between the power plant and the motors is approximately 20 per cent.—Lond. *Elec. Eng.*, October 31.

TRACTION.

Repulsion Motors for Single-Phase Traction.—CRAMP.—A communication in which he expresses himself quite strongly in favor of the single-phase repulsion motor, his opinion being based upon a series of experiments made by Faussett and Ablett. "A continuous-current motor with laminated magnetic circuit" is said to be really only one type of the repulsion motor, and in fact one of the worst types, very inefficient and troubled with vicious sparking. The latter fault is of course met with in most forms to a larger or smaller extent, but they have entirely overcome it "with the help of special yet simple construction," which however is not described. They have also found that the efficiency of the machine may also be considerably improved by means of special windings. Ablett has also recently found that the starting torque is entirely a question of design, that is to say, that the motor may be arranged to start under full load almost equally well with small currents and low power factor or with large currents and high power factor; but in no case need there be large currents and low power factor as in the single-phase induction motor. With regard to Lamme's objection to the repulsion motor, on the ground that it is difficult to reverse the direction of rotation, their experience is that the reversal of the repulsion motor can be easily effected; and if the movement necessary to cause this is performed while running, the motor immediately begins to act as a powerful electric brake. The repulsion motor has the advantage over the alternating-current series motor in that the motor and commutator are in no way connected with the transmission line or stator windings, so that there may be a low pressure on the commutator, while the pressure of the line or stator is very high.—Lond. *Elec.*, November 14.

Single-Phase Railway Systems.—GEIPEL AND LANGE.—A communication referring to a recent criticism of the Ward Leonard system, in which it was said that while with the converter system a train can be moved from rest at a slow speed with a smaller current than in the ordinary method, yet if the train is accelerated at the same rate up to the same speed in both cases, the maximum current in the motor must be the same if the weights are the same, and since the converter-equipped train weighs more than the other, it will not take a small but a larger maximum current to start. The present writers point out that although the maximum current might be greater, yet that current is required at a low voltage; it is one of the

objects of the Ward Leonard system to avoid drawing the large current which is required for starting and accelerating, direct from the line. In an editorial note it is said that the same claim had been made by Mordey and Jenkin, but that its fallacy had been pointed out by Wilson and Kapp, who showed that there is a time during starting when both large current and full voltage are required simultaneously in the motors, so that the maximum power is not reduced by this system. The power required at starting is not affected by the fact that the line voltage may be transformed down in the converter; the question is entirely one of fluctuations of power.—Lond. *Elec.*, November 14.

Graphical Presentation of Street Railway Statistics.—Gotshall.—An article in which he calls attention to the importance of comparing the records of each week and month with those of the same period during the preceding years and believes that these comparisons can most easily be made graphically. He gives as a sample some curves showing the cost of power stations, repairs, train men, and receipts per car-mile of the railroad with which he was connected in St. Louis. He also suggests that many valuable lessons can be taught by plotting out street railway statistics; as, for instance, on one line the kw-hours per week and month and on the line below it the kgms of coal burned during the same periods. If the station efficiency is constant, these lines as plotted will remain the same distance apart, although each will have fluctuations depending upon the output. If, however, through the use of an inferior quality of coal or for some other reason the station production becomes less efficient, the coal line will approach closer to the kw-hour line. If on the same chart another line is drawn showing the car-miles, and the kw-hour line approaches the car-mile line, it shows that more power is being taken per car than formerly. The same system can be used for comparing the earnings and other data of various street railways, and he gives as an example of this a reproduction of a chart to show the relative time required by the different railways between Portchester and New York City.—*St. R'y Jour.*, November 1, and *Int. Ed.*, November.

Electric Heating of Tramway Cars.—An illustrated article. It is said that generally a consumption of 80 to 100 watts per seat is counted upon, to get under normal conditions a temperature of 54 to 59° F. There are installations in which 65 watts per seat are sufficient; 100 watts suffice in the coldest days. The electric-heating apparatus of the Schindler-Jenny system are described. The heating wires are closely embedded in an insulating material which itself is contained in a metallic cover. One thousand watts are said to suffice for heating a car of 16 to 20 seats.—*L'Ind. Elec.*, October 25.

Installations, Systems and Appliances.

Central Station Statistics of Switzerland.—An abstract of the report of the Swiss Electrical Society on the electric stations in Switzerland. There are 235 plants, of which 194 are municipal and 41 private. In 215 plants water power is used, in 14 gas or petroleum engines, in 6 steam engines; 20 of the 215 hydroelectric plants contain steam engines as reserve. The 215 water-power plants have a total capacity of 104,900 kw; the 14 plants with gas or petroleum engines 2,700 kw; the 6 steam plants 3,300 kw; the total capacity is therefore 110,900 kw. Only 11 plants have a capacity of more than 3,000 kw. 104 plants use single-phase or two-phase or three-phase alternating-current, 101 plants use direct current, and 11 plants a combined alternating and direct-current system. The energy is used in the following industries: 64,700 kw or 63 per cent. are used for electric light and power, 14,400 kw or 14 per cent. for electric traction, and 24,000 kw or 23 per cent. for electrochemical purposes; but 15,000 kw of the latter are not used at present on account of the critical condition of the calcium carbide industry. The Swiss Electrical Society has appointed a committee for inspecting electric plants; the government gives for this purpose a subvention of 10,000 francs ($2,000); the number of plants which have subscribed for inspection, increased from 30 in June, 1898, to 251 in June, 1902. The total number of inspections was 318 during 1902, i. e., an average of 1.26 per subscriber. This committee also makes tests of insulation materials.—*Elek. Zeit.*, November 6.

REFERENCE.

Contact Surfaces in Apparatus.—Hellemund.—An article on the choice of the proper dimensions of contact surfaces and screws of electric apparatus.—*Zeit. f. Elek.*, October 12, 19.

Electro-Physics and Magnetism.

Dynamics of the Electron.—Abraham Kaufmann.—Two papers on the fundamental conceptions concerning electrons. Abraham develops a dynamical theory of the electron as a basis of an electro-magnetic system of dynamics. He starts from the supposition that the electron, as it appears in free motion in the cathode and Becquerel rays, is a sphere, in the volume of which the electric "charge"—whatever that may be—is equally distributed. The "electricity" is to be contained in the volume elements of the electron just as ordinary matter is contained in volume elements of a rigid body. The whole dynamics of the electron are based upon a fundamental kinematical equation, the Maxwell-Lorentz field equations, and a fundamental dynamical equation which implies that the resultants of the inner and outer forces and couples vanish. The main differences between this kind of dynamics and ordinary dynamics are that the electro-magnetic dynamics applies to velocities nearly as high as that of light, whereas ordinary dynamics applies only to small velocities. Kaufmann proves by the exact agreement of a series of tests with a formula of Abraham, that the "mass" of the electron is purely apparent and due to electro-magnetic inertia.—*Phys. Zeit.*, October 10; abstracted in Lond. *Elec.*, November 7.

Velocity of Röntgen Rays.—Blondlot.—An account of experiments in which, by a method resembling that of Roemer for determining the velocity of light, he found that the velocity of Röntgen rays is of the same order as the velocity of Hertzian waves.—*Comptes Rendus*, October 27; abstracted in Lond. *Elec.*, November 14.

Loss of Weight of Radioactive Substances.—Heydweiller.—An article in which he reaches the conclusion that the energy of radium rays is due to the conversion of gravitational potential energy into radio-activity. He finds that the loss of weight of a radio-active substance is much greater than was supposed by Becquerel. One of de Haen's "concentrated" radium preparations lost 1 mgm in 50 days while enclosed in a sealed glass tube, the loss of weight observed per day being 0.02 mgm. He points out that the amount of energy of radioactivity is strikingly similar to the amount of potential energy lost in the earth's gravitational field. The substance loses potential energy at the rate of 120,000,000 ergs per day. This amount is recovered to the extent of 100,000,000 ergs per day in the form of radio-active energy.—*Phys. Zeit.*, October 15; abstracted in Lond. *Elec.*, November 7.

Sparking Distances.—Earhart.—An illustrated article on a series of measurements of sparking distances. The main difficulty was to measure a small distance accurately, which was done by the interferometer method. In a diagram he gives the results obtained with air under ordinary atmospheric pressure, as a dielectric. From ½ to 2 microns the potential required for discharge varies directly with the distance. At about the latter point the curve takes a sudden bend and proceeds in nearly a straight line, varying with the distance but according to a different law. If the theory of an air film surrounding the surfaces of bodies is accepted, the sudden variation in the form of the curve would indicate the thickness of such a film as being about 1 micron.—*The Rose Tech.*, November.

Magnetic Reluctance of a Stretched Iron Bar.—Fraichet.—A description of an experiment in which an iron bar was made the core of an induction coil, the primary winding being supplied with direct-current. The terminals of the secondary coil were connected with a galvanometer. When the bar is stretched, the fibres of the iron, being not all identical, break one after the other. The galvanometer shows a series of jerks as soon as the elastic limit is surpassed, each jerk meaning the rupture of a fibre and indicating the size of the fibre by the extent of the swing. A bar of hard-tempered steel possesses no fibre, and, therefore, the flux traversing it varies continuously until the metal is ruptured.—*Comptes Rendus*, October 27; abstracted in Lond. *Elec.*, November 14.

REFERENCE.

Electron Theory.—Lorentz.—A highly theoretical paper on "the fundamental equations for electro-magnetic phenomena in ponderable bodies, deduced from the theory of electrons."—*Proc. Roy. Akad.*, Amsterdam, September 27; abstracted in Lond. *Elec.*, November 7.

Electro-Chemistry and Batteries.

Price of Bleaching Powder.—An editorial note on the failure of the convention between the English and foreign producers of heavy chemicals, which may be serious for the new electro-chemical works

which depend upon bleaching powder for their profits. During the past four years bleaching powder has been artificially maintained at an average price of $30 per ton. Contracts have now been signed for the delivery of large quantities at the low price of $20 per ton; should the price fall to $17.50 a ton, many of the electrolytic alkali works would find themselves in an unenviable financial position.—Lond. *Elec.*, November 14.

Recovery of Tin from Tin-Plate Scrap.—A note on a Swedish patent of Bergman. The scrap is placed in an iron vessel filled with a solution of caustic alkalis, together with a depolarizer; there will be electrical action, in which the scrap is stripped and the tin goes into solution, from which the tin is precipitated as oxyhydrate by means of a current of carbon dioxide; the precipitate dissolved in acid is electrolyzed for the tin.—*Chem. Zeitung*, 1902, p. 625; abstracted in *Eng. & Min. Jour.*, November 15.

Copper-Depositing Plant.—A brief illustrated article on a copper-depositing plant which has recently been erected by an English company "for the purpose of forming the reflectors, or rather refractors manufactured by them. These reflectors are made by mounting a series of prisms in light frames made of metal strip, and on the edges of these strips copper is deposited to form a beading which naturally adapts itself to the shape of the edges of the glass prisms, and holds them rigidly in place." No further description is given. The depositing plant consists of two multipolar dynamos, each giving 1,000 amperes at from 2½ to 5 volts.—Lond. *Elec. Rev.*, October 10.

REFERENCES.

Electrometallurgy.—BEADLE.—A series of articles on electrometallurgical problems, especially discussing the methods which have been proposed for producing metals from the ores. The first three articles deal with copper, lead and zinc, but do not seem to give anything new.—Lond. *Elec. Rev.*, September 26, October 10, 24.

Electrolysis and Physiology.—BERTHELOT.—An account of an investigation of certain voltaic cells whose behavior has an important bearing upon the physiological action of the animal cells composing the human body; he studied more especially the very small chemical transformation accomplished in a single animal cell during the impact of a single blood-wave.—*Comptes Rendus*, September 29; abstracted in Lond. *Elec.*, October 31.

Manchester.—WALKER.—An illustrated description of the electrochemical laboratory at Owens' College, Manchester. This is the first laboratory opened in England for the study of and research in electrochemistry and electrometallurgy. It is under the direction of R. S. Hutton.—*Eng. & Min. Jour.*, November 15.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Tesla Transformers.—DRUDE.—An article on the construction of Tesla transformers. The main problem is to establish magnetic resonance between a coil of a few turns attached to a capacity, with a coil of many turns without terminal capacity. This involves a lengthy process of trial and error, especially in the construction of powerful transformers. The author has therefore worked out a method of calculating the period of the secondary coil and the inductance of the primary. Incidentally some points of importance for radio-telegraphy are touched upon. The period of oscillation of various coils of wire was determined by exciting them by means of an exciter of known dimensions and noting their maximum resonance. Results obtained on one coil can be transferred to another and geometrically similar coil by simply multiplying them by the ratio of any homologous linear piece. To obtain maximum efficiency wood should not be used for cores of coils; ebonite or glass are preferable. Cotton insulation of the wires increases the period by about 1.5 per cent., if its thickness is equal to that of the wire. The period of a coil is always increased by a terminal capacity, but is never doubled. —*Ann. d. Phys.*, No. 10; abstracted in Lond. *Elec.*, November 7.

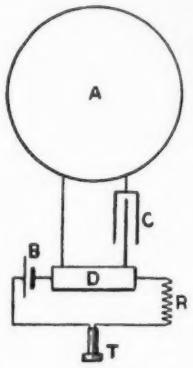
Determining the Period of Rapid Oscillations.—DRUDE.—A description of a method of determining the period of rapid oscillations of condenser discharges of wave-lengths varying from 10 to 100 metres, such as used in Braun's application of oscillatory condenser discharges to wireless telegraphy. For short waves, of lengths less than 12 metres, the primary condenser circuit whose period is to be determined, excites a secondary circuit consisting of two accurately parallel copper wires, 1 mm thick, joined permanently at one end, while at the other a metallic yoke can be displaced along the wires until accurate resonance is obtained, as indicated by a maximum luminosity of a vacuum tube laid in the center between both ends. Then the wave-length equals the total length of the secondary circuit plus the length of the yoke, plus 3 cm, the latter being due to the capacity of the luminous tube. For longer waves, the author uses a parallel circuit 2 m long, which at one end contains a condenser consisting of two circular plates, whose distance can be nicely regulated and accurately determined; the wires are bridged by a movable yoke, and maximum resonance is tested by a vacuum tube applied to one condenser plate.—*Ann. d. Phys.*, November 11; abstracted in Lond. *Elec.*, November 14.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Marconi's Experiments.—MASKELYNE.—An article presented as "a supplement to Lieut. Solari's report on the radio-active expedition of H. I. M. S. *Carlo Alberto*," which was recently abstracted in the Digest. While these experiments have proved that wireless telegraphic messages could be transmitted successfully from England over continental Europe to the ships in the Mediterranean Sea, the present author proves, by means of a reproduction of records recorded, that these messages were successfully intercepted by a station outside of the Marconi company. It appears that the syntonic system, which had been claimed to have been perfected, was either not used or is ineffective. The international conference proposed by the government of Germany is said to be something for which the time is absolutely ripe. "It is time that the matter should be publicly thrashed out. Above all, it is time the public realized that so-called wireless telegraphy is, properly speaking, not telegraphy at all. It is merely a means of signalling invaluable in its own special field, but which can only be employed when time, place and circumstances permit."—Lond. *Elec.*, November 7.

An editorial on the same subject, in which it is said that "wireless telegraphy stands before us to-day as an object both for pity and for anger. * * * It has generated into a mockery of the fair repute of science."—Lond. *Elec. Rev.*, November 14.

Telephonic Detector for Wireless Telegraphy.—JERVIS-SMITH.—A communication in which he describes an instrument which he believes to be serviceable for practical working in inductive telegraphy. Bleekrod has described a coherer consisting of steel needles resting on carbon blocks. The combination was found to decohere so that a telephone could be used in connection with it to detect the transient influence of the Hertzian wave. The present author repeated the experiment and enhanced the effect by imparting a very slight vibration continuously to the coherer. A system of steel rods and carbon blocks was supported on a piece of thin wood; this was so attached to a Morse instrument that the roughened roller which feeds the paper slip touched the wooden support; the contacts were by this means very slightly shaken and a slight buzzing sound was produced in the telephone. But when the system was influenced by the Hertzian wave the telephone gave out very loud and clear ticks. The apparatus was used also in connection with a large coil which played the part of a secondary coil, the primary coil being at a distance. The large coil (12 ft. in diameter) was connected to the coherer through a condenser of about 1/5 microfarad, which permits the electricity due to induction to act on the decoherer or coherer without short-circuiting the circuit of the coherer. The connections are shown in the adjoining diagram, which *A* is the large coil, *C* the condenser, *D* the coherer, *B* the battery, *R* a resistance, and *T* the telephone. The primary coil was similar in size to the secondary, but made of thick wire ⅛ in. in diameter, the ends of which were attached to the outer coatings of two Leyden jars standing on a sheet of ebonite, their inner coatings being connected to the terminals of an ordinary induction coil, a high-pressure spark-gap taking the place of the usual knobs between which the spark passes. This method of forming the circuit he finds to be far the best; also in the case of the Tesla inductor. The primary and secondary coils were placed so that their planes were at right angles to a common axis passing through their centers. If the coil *A* be rotated through 90° the effects are greatly diminished, but not entirely extinguished; the correct position of the coils can be found by taking the magnetic bearing at each station. When, instead of a telephone, a dead-beat galvanometer is used, the deflections are definite and easily read. His experiments were made over the rather short distance of 1¼ miles.—Lond. *Elec.*, November 7.



TELEPHONE DETECTOR.

REFERENCE.

Statistical.—A statistical article on telegraphy and telephony in Great Britain in the financial year ending March 31, 1902. Also the conclusion of the report on telegraphy and telephony in Switzerland in 1901 and an article on telegraphy and telephony in Norway in 1899 and 1900.—*Jour. Teleg.*, October 25.

MISCELLANEOUS.

Preparation of Turf by Electricity.—Delahaye.—An article on a process used in Stanzfjorden, Norway, where an electric-lighting, power and heating plant was installed in 1898. The price of turf in that locality is extremely low and there is an entire absence of coal and wood, while electric power is available in large quantities and low cost. It was therefore decided to remove the water from the turf by electrical means in order to use it for heating purposes. The turf is pressed into blocks of a size 80 by 88 cm, by means of a 5-hp motor, 2,500 blocks being pressed per hour; these are placed on cars, each carrying 140 blocks, and a train of such cars runs into the "drying tunnel" where a hot stream of air meets it, the temperature being 40° to 50° C. at the entrance and 90 to 100° C. at the exit. The drying installation contains a hot-air generator which is fed with the gases escaping from the dry distillation of the turf; there are also three electric ventilators. After this preparation the blocks are placed in iron cylinders of 1 m diameter and 2 m height, with movable covers, which contain manometers and cocks for the escaping gases and steam. The temperature required for the evaporation of the steam and the dry distillation is produced by electric resistances arranged in a zig-zag, around which the turf is placed; the design of the furnace prevents losses by radiation. From 100 kg of raw turf there are obtained 33 kg of fuel, 4 kg of potash, 40 kg of ammoniacal waters and 23 kg of burnable gases. The fuel contains 76.9 per cent. of carbon, 4.6 hydrogen, 8.2 oxygen, 1.8 nitrogen, 4.8 water, 0.7 sulphur and 3 ashes. The fuel sells well.—*Revue Ind.*, July 26; abstracted in *Zeit. f. Elek.*, October 12.

Removing Hair by Electricity.—Guilloz.—An article on the electric method of removing hairs which is said to be both the slowest and the surest. The cathode is the fine needle of platinum, gold or, still better steel, which is introduced along the hair down to the bottom of the bulb. A current of 1 or 2 milliamperes is passed for a time varying from 20 to 50 seconds, which acts as an effective galvanocautery. The intensity of the current may be increased if the patient can bear it, and the time of operation diminished proportionally. The hydrogen disengaged round the needle in the shape of a slight whitish foam forms a guide as to the process of the action, and when it is finished the hair comes out withont any effort, taking with it a number of inflated clear cells surrounding it like a sheath. According to Giovannini the cells of the epithelium and the endothelium are especially sensitive to the action of the current, whereas the epidermis and cornea resist better, so that the destructive action of the current always acts upon the bulbs of the hair, although the needle may not touch them exactly.—*Arch. d'Elec. Med.*, October 15; abstracted in Lond. *Elec.*, November 14.

Ocean Wireless Telegraphy.

The *New York Sun* quotes Mr. Marconi as follows: "I will confirm the report that messages were received by me on board the Carlo Alberto in Sydney Harbor from the station at Poldhu, Cornwall. I am only too pleased to confirm any announcement made by the Italian Government, but, according to the terms of my agreement with the government, they are to make public the results of my experiments on board the warship, and I cannot give you any further information regarding those experiments as a result of my work here. Several improvements have been made both in the transmitting and receiving apparatus, and we are now able to send at a rate of forty words a minute, while a year ago our best speed was sixteen or seventeen words a minute."

Brussels-Antwerp Railway.

English capitalists, it is said, have offered to deposit a guarantee of $2,000,000 with the Belgian government in return for a concession to construct an electric railway from Brussels to Antwerp. The syndicate will complete the line in eighteen months and will run trains that will cover the twenty-six miles between the two cities in twenty-two minutes.

New Books.

Magnetismo e Elettricita. Hoepli Manual, 1902. By F. Grassi. Milan: Ulrico Hoepli. 608 pages, 280 illustrations.

This is one of the series of well-known pocket-books published by Ulrico Hoepli, of Milan, Italy. The author covers in an elementary way all the subjects relating to electricity and its application. The presentation, while simple, is, however, attractive for the clear exposition of the fundamental principles of theory and apparatus described, as well as for the large amount of historical information given pertaining to different inventions and modern applications.

BOOKS RECEIVED.

Electricity and its Similitudes. The Analogy of Phenomena Natural and Spiritual. By Charles H. Tyndall, Ph. D., S. T. D. New York: Fleming H. Revell Co. 207 pages, 9 illustrations. Price, $1.00.

Elektromotoren fur Gleichstrom. Von G. Roessler. Berlin: Verlag von Julius Springer. 136 pages, 49 illustrations. Price, 4 marks.

Leitfaden zur Konstruktion von Dynamomaschinen, Und zur Berechnung von Elektrischen Leitungen. Von Dr. Max Corsepius. Berlin: Verlag von Julius Springer. 269 pages, 108 illustrations. Price, 5 marks.

Manual of Rural Telephony. By J. A. Williams. Cleveland: Manual Publishing Company. 177 pages, 104 illustrations. Price, $1.00.

Notes on the Laying, Repairing, Operating and Testing Submarine Cables. By Captain Edgar Russel, U. S. Signal Corps. With a Supplementary Chapter on Factory Testing, by Lieut.-Col. Samuel Reber, U. S. A. Washington: Government Printing Office. 70 pages, illustrated.

Theoretical Elements of Electrical Engineering. By Charles Proteus Steinmetz. New York: Electrical World and Engineer. 323 pages, 144 illustrations. Price, $2.50.

Directory of Electrical Societies, Etc.

American Institute of Electrical Engineers, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings: December 19th, "Braking and Traction Brakes," J. D. Keiley and R. A. Parke; January 23d, 1903, "Telephone Exchanges"; February 27th, "Railway Train Lighting," Wm. L. Bliss, Lamar Lyndon and A. J. Farnsworth; March 27th, "High-Tension Lines," Ralph D. Mershon; April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

Association of Edison Illuminating Companies. Secretary, W. H. Johnson, Philadelphia, Pa.

Canadian Electrical Association, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

The Electrical Trades Society (Member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

Engine Builders' Association, D. N. McBrier, Erie, Pa., Secretary.

Interstate Independent Telephone Association, Secretary, E. M. Coleman, Louisville, Ky. Next meeting, Chicago, December 9, 10 and 11, 1902.

Kentucky Independent Telephone Association, Secretary, H. K. Cole, of Lancaster, Ky.

National Electrical Contractors' Association of the United States, Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich., July 15, 1903.

National Electric Light Association, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 1903.

New York Electrical Society, Secretary, G. H. Guy, 114 Liberty Street, New York.

Southern Indiana Telephone Association, Secretary, E. W. Pichardt, Huntingburg, Ind.

NORTHWESTERN ELECTRICAL ASSOCIATION, Secretary, Thos. R. Mercein, Milwaukee, Wis.

OLD-TIME TELEGRAPHERS' AND HISTORICAL ASSOCIATION, Secretary, John Brant, 195 Broadway, New York.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION, Secretary, John Ruth.

VERMONT ELECTRICAL ASSOCIATION, Secretary, C. C. Wells, Middlebury, Vt.

U. S. MILITARY TELEGRAPH CORPS, Secretary J. E. Pettit, Postal Telegraph Company, Chicago, Ill.

The Application of Telpherage to Freight.

BY H. MCL. HARDING.

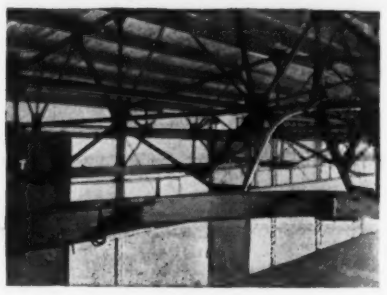


FIG. 1.—FREIGHT HOUSE TELPHER LINE.

At the present moment when one hears so much about freight congestion on the main lines of steam railroads, it is unusually pertinent to inquire whether the application of such a system as electric telpherage might not be availed of, if not to prevent such increasing trouble at least to alleviate it very considerably. The present system of handling miscellaneous freight at terminal stations is absurdly slow and expensive as compared with progressive methods used in all other branches of railroad management. Time, attention and money have been lavishly given to such problems as decreasing the amount of coal consumption and reducing the cost of maintenance of the roadbed and the rolling stock, but up to the present time, apparently, it has seemed impossible to lower the cost of loading, unloading and storing freight Here is to be found, if it were carefully followed up, the secret of the slow delivery of which so many merchants complain. It is like the delay of a telegraph message, which will go over the wire in a flash, but may stay for hours on the operator's hook awaiting the attention needed to put it over the line.

Concerning the unloading of freight, the following data may be of interest:

In the United States, Canada and Mexico there are approximately 1,500,000 freight cars costing $750,000,000. Of this number 90 per cent., or cars valued at $675,000,000, are idle. In other words, a freight care moves on an average about two hours a day, and is idle for twenty-two hours. This is largely due to the fact that the cars must remain so long on the tracks in freight yards waiting their turn to be unloaded. By means of overhead electric carriers or telphers these cars can be unloaded and loaded when at any position in the yards, and need not be moved to the freight station.

The work to be done may be divided into three parts: (1) Taking freight from the cars on the tracks to the warehouses or freight sheds; (2) transferring it to wagons or trucks for local distribution; (3) taking it to other tracks, where it is loaded in cars for smaller cities.

A large proportion of the handling of freight, especially the distributing, assorting and tiering, is done by men. The carriers and hoists, taking advantage of the flexibility of electricity and the ease with which it may be controlled, as well as of its cheapness, make it possible to reduce terminal expenses to their proper proportion in the cost of the "haul." Electricity, under the name of telpherage, is doing for the transportation of freight what it has accomplished in street railways for the transportation of passengers, with results even more gratifying, because the need is more urgent. In the case of street railways the question was electricity vs. horse power. In the case of freight yards it is electricity vs. man power. There is, of course, no power so costly as man power and none so cheap as electric power in handling material. Obviously, then, no method of saving is more desirable than the substitution of electricity for manual labor.

As to the second point, the transferring of freight from the cars, freight sheds or warehouse to wagons for local distribution, or from wagons to the freight houses or directly to the cars, telpherage is calculated to do the work much more satisfactorily than it can be done by any other method. When a load is brought in from the yards, it may be placed exactly where it is desired, that is, it may be carried in through any one of a number of openings and deposited at any one of a number of unloading stations. That portion of the freight for local distribution will be carried by a telpher through the freight houses to the doors or openings where wagons are stationed.

The tracks are so arranged in loops and at such an elevation as to pass above the wagons. The load can be either taken from or delivered to the pier sheds or freight stations from the wagons without any manual labor. There is also a great saving of time, avoiding the necessity of the long waits by the teamsters, obviating the confusion and crowding of the long lines of trucks waiting for their "turn" to load or unload, saving much of the space reserved for horses and wagons. Time, therefore, being saved and heavy lifting rendered unnecessary, a railroad or steamship line thus using electricity is naturally popular with shippers and teamsters. The saving in labor for the transportation company is so great as to be almost incredible.

The handling of freight to be reshipped is vastly facilitated by electric conveying, whether the material is sorted in the cars in which it is originally shipped and taken directly to other cars bound for other and smaller cities, or whether it is to be removed to the freight house, sorted and then taken back to the yards. Since double tracks may be used in the yards or a single track may be laid out so as to form a circuit with numerous cross-covers, as many telpher carriers as are needed may be employed and the two operations of loading and unloading go on simultaneously.

It is impossible to explain here such details as track scales, suspended scales for weighing and the devices used by freight agents for

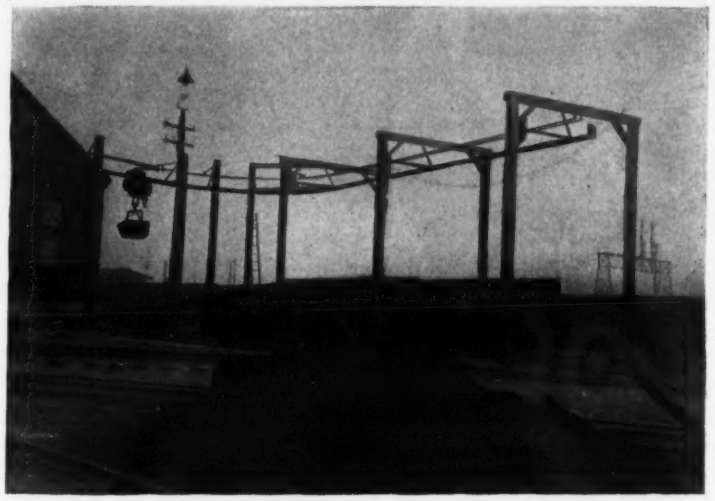


FIG. 2.—TELPHER TRACK IN FREIGHT YARD.

examining and sorting packages. These points have, of course, received careful attention, as they are of great importance in increasing the speed with which the work may be done. Inspectors' houses can be constructed at convenient locations upon the line, through which the telphers and load must pass, for weighing, marking, checking and inspecting the various kinds of freight.

The speed on straight, level stretches can be 800 to 1,500 feet per minute. This may be increased if experience proves it desirable. The amount of power consumed during an average day of ten hours should be, measured by meter, not more than one horse-power per ton. This includes both hoisting and conveying. If the line be one which employs a telpherman, he should receive a little less than is uusually paid to the motorman of a trolley car in that vicinity. If he controls the telpher and hoist from the truck platform, he can readily assist in the loading and unloading, besides attending to the weighing, attaching, hoisting and conveying. A usual method, however, is to have a number of trucks, and while the loaded trucks are being transported the empty trucks are being loaded, so that the telpher only stops long enough to attach and detach the trucks, replacing empty with full ones. In many cases, as soon as the hoist has lifted the load just clear from the floor, the telpher commences to transport.

The cost of maintenance should be very small. The telpher driving wheels are of very hard steel, and, even when in continuous use, should last for a long period. As they are of small diameter they may be replaced easily at an expense of only a few dollars. The track is protected from dirt and grit, since it is overhead. It is strong, and, as it supports light weights in comparison with those

supported by the tracks for steam locomotives, is calculated to have exceptionally long life. The maintenance of the supports is the same as for ordinary steel or wooden supports for any overhead structure.

Among the most obvious advantages of overhead electric carriers, as used in handling freight, are that: No ground or floor space is required, the tracks being equivalent to a second story. No drays are used on or between the tracks. Lifting and rehandling are reduced to a minimum. The loading and unloading are done so rapidly that not only can much of the congestion now noticeable in all important freight yards be avoided, but it is also possible by telpherage either to double the capacity of any freight yard or to decrease its size by one-half. Smaller storage stations or sheds will be adequate, since there will be little delay in sorting the freight and removing it for distribution. The load, whether in the form of boxes, barrels or buckets, can be deposited just where it is needed. Hand tiering will be avoided, as will also the slow, laborious lifting of box upon box or barrel upon barrel.

The application of electricity to industrial purposes is not new, but up to the present time the large electrical manufacturing establishments have concentrated their energy and their capital upon the development of electric lighting and heating plants, stationary motors

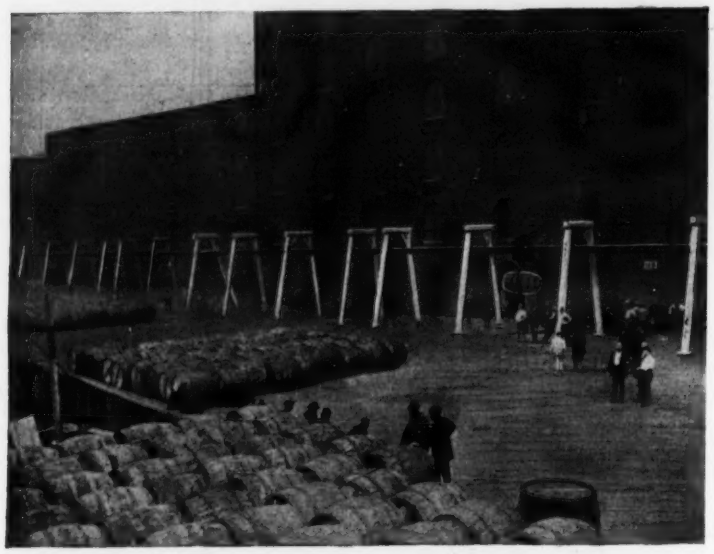


FIG. 3.—TELPHER LINE HANDLING SUGAR HOGSHEADS.

and various minor devices. Those connected with the application of electricity to the transportation of material, or telpherage, have been in the past closely identified with the introduction of electricity in the street railway system. To them it seemed, as it must to every one who investigates the subject, that the next step was logically the commercial development of the application of electricity to the handling of material along the lines indicated.

Optical Principles and Electric Light Reflectors.

It is a well-known law of optics that the inside face of a polished glass surface will reflect all rays striking it at an angle of 45° or more. Now if two polished glass surfaces are placed at 90° to each other, any ray of light striking the first surface at 45° will be reflected on to the second surface striking it also at 45° and being reflected back parallel to its original direction, as shown in Fig. 1. A ray of light *L* striking the glass surface *B C* perpendicularly passes through, strikes the inside of surface *A B* at 45°, practically *all* the light is reflected on to surface *A C*, where it is again reflected, emerging through the surface *B C* into direction *L*¹.

Making use of this optical law, a prismatic reflector has been placed on the market, which although made of absolutely transparent glass, and devoid of any silvering amalgam or white surface, yet makes a most efficient reflector, is rich and sparkling in appearance, and sold at a moderate price. For these "Pagoda" prismatic reflectors, several advantages are claimed. Compared with white opal reflectors, they are said to be more efficient and are certainly more decorative and rich looking. It is said that they are quite as efficient concentrators of light as the silvered or the mirror reflectors, while they do not cut off all the upward and side light. Then again there is nothing to get out of order or tarnish about them. The cut (Fig. 2) will give a general idea of this new prismatic reflector, which has a good deal of the appearance and sparkle of cut glass. These reflectors are being manufactured and sold by the Holophane Glass Company, who bring to bear on their manufacture all the scientific experience embodied in their well-known Holophane prism globes. A very useful innovation, and one that will be appreciated by those who use electric lamps in very large quantities, is a small prismatic

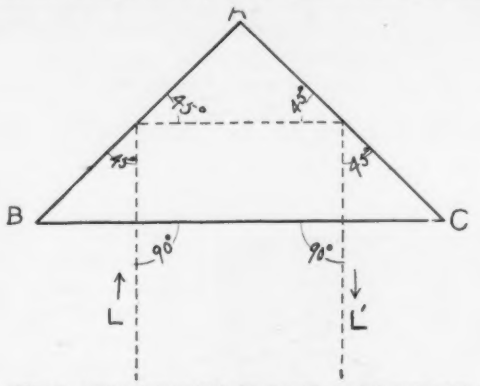


FIG. 1.—ILLUSTRATION OF LAWS OF REFLECTION.

reflector which is made to rest on the electric bulb itself without the need of a holder. Where hundreds or thousands of electric lamps are used, the first cost of getting a suitable holder for each often is the cause of their remaining bare. By dropping over the electric lamp a small "Pagoda" prismatic reflector, such as we describe, all the efficient light concentration downward of a larger reflector is obtained at a very small first cost.

In a recent interview with the president of the Holophane Co., the

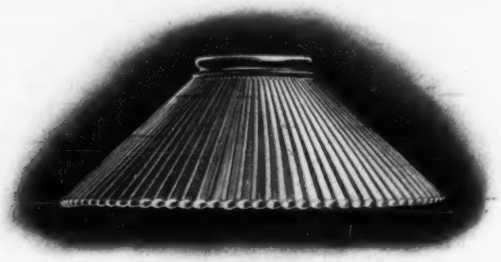


FIG. 2.—PRISMATIC REFLECTOR.

difficult points involved were explained. Two prism glass globes were shown apparently identical (Figs. 3 and 4). They were the same size, shaped alike, both ribbed vertically inside and horizontally outside; in fact the following two cuts are made like these two globes. It is evident that the ordinary unscientific mortal can see no difference between two such globes.

Over a light and tested by a photometer, the Holophane with its calculated prisms was found to give nearly double the efficient

FIG. 3.—UNCALCULATED RIBBING.

FIG. 4.—GLOBE WITH CALCULATED PRISMS.

illumination in all downward directions, over the non-calculated globe. They were twins in appearance only; the scientific article increases the light value received while diffusing its rays; the unscientific globe wastes light without diffusing the glare. Just as Dalmeyer, Goetz or Bausch & Lamb photographic lenses look just like any other lens to the eye, so a scientifically ribbed glass looks just like an ordinary ribbed glass to the eye. A reflector covered with

vertical prisms carefully made with finely polished surfaces at 90° will reflect over 90 per cent. of light, and can be made to concentrate downward as powerful a light as a silvered reflector. Exactly the same shape and size reflector covered with exactly the same number of prisms but at each having an angle of 120° instead of 90° will not reflect or concentrate any light. Yet off the light, the two reflectors are identical in appearance.

The Holophane Glass Company now have a well-earned reputation for turning out scientific glass globes, and as the same glass and care is applied to the making of these prismatic reflectors they should find a ready sale. In order to distinguish these prismatic reflectors from the Holophane glass, the trade mark "Pagoda" has been adopted, a name suggested by their appearance resembling that of the pagoda temple roof of India.

New Russell-Tomlinson Telephones.

The Russell-Tomlinson Electric Company, of Danbury, Conn., has been introducing an improved type of its "New Standard" telephone, Fig. 1. This instrument is fitted with a new solid back transmitter which has the working parts of the company's long distance instrument. This instrument is fitted with a double pole watch case receiver, and is high in efficiency. Each telephone is equipped with an induction coil, and is built on the lines of the long distance apparatus. It is designed for circuits up to 2,000 feet, and is suitable for hotel installation, etc. The cut (Fig. 3) shows the company's long distance transmitter. This is built on lines of the solid back, and can be accurately adjusted.

FIGS. 1 AND 2.—TELEPHONE AND RECEIVER.

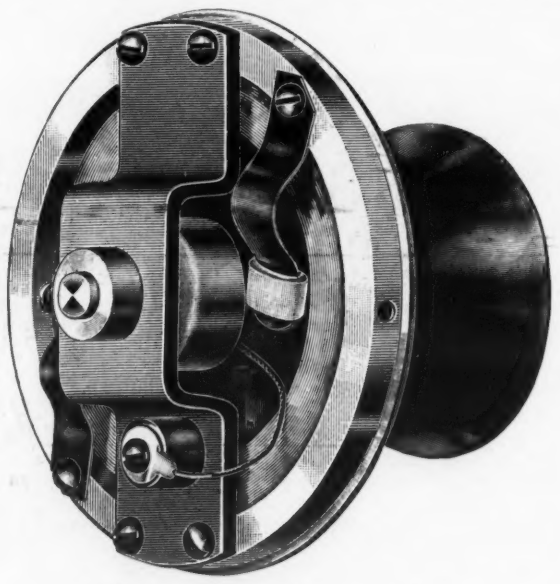


FIG. 3.—LONG-DISTANCE TRANSMITTER.

An improved desk set is one of the new productions. The essential features are that all contacts are platinum, and working parts are encased in the base of the instrument, which is absolutely dustproof and easy of access. The new self-contained receiver is shown in Fig. 2. This receiver has all the working parts in metal, which does away with the expansions and contractions that happen when metal parts are cast in the receiver shell.

Central Energy Telephones for Mines and Interurban Railways.

A new central energy mine and railway telephone set, especially designed to meet the conditions of bad weather, hard usage and places where high potential currents abound, is shown herewith in Figs. 1 and 2. This outfit is made by the Stromberg-Carlson Telephone Manufacturing Company, Chicago, Ill., and Rochester, N. Y. The iron box which protects the telephone proper, is said to be weather-proof and absolutely water-tight. The line connections are brought into the box through a double elbow, at the top, as shown, thus eliminating any chance of water coming in contact with any connections in the box. The mechanism is completely protected by the inner case, which is locked and only accessible to the person having charge of the maintenance of the system. The various parts of the apparatus are mounted on the inside of the inner case door, which, when it is open, reveals all parts in a manner convenient for inspection, test or repairs. The equipment of a single telephone consists of one long distance transmitter, one bi-polar receiver, platinum contact hook switch, metallic carbon and fuse lightning arrester connectors, and all parts necessary for the complete operation of a central energy system. All metal parts are non-corrosive, all circuits are wired with the best grade of rubber insulated wire and all parts are interchangeable.

FIG. 1.—MINE AND RAILWAY TELEPHONE.

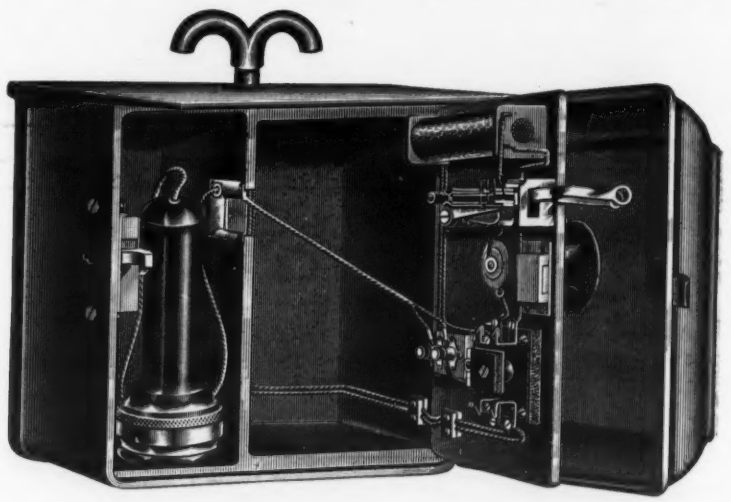


FIG. 2.—INTERIOR VIEW OF MINE AND RAILWAY TELEPHONE.

The line cut-out device is provided when specified and is intended as an absolute line disconnector, when the receiver is hung on the switch-hook and the outer case door closed. This makes it impossible for any high potential current arcing to take place in the case when the apparatus is not in use, the carbon and fuse arrester being permanently connected to outgoing lines.

That part of the equipment shown in Fig. 3 is known as the cut-in station, and is intended for use in connection with the instruments already described and shown in Figs. 1 and 2. This box is weatherproof, provided with hinges and lock and made of heavy cast iron. It is so constructed that it may be used without unlocking. In the lower end of the box an opening is provided with a self-closing trap door, which may be opened by pressing upwards. This equipment consists of a bridging jack with heavy german silver reinforced springs, and mounted on a heavy hard rubber base, with heavy

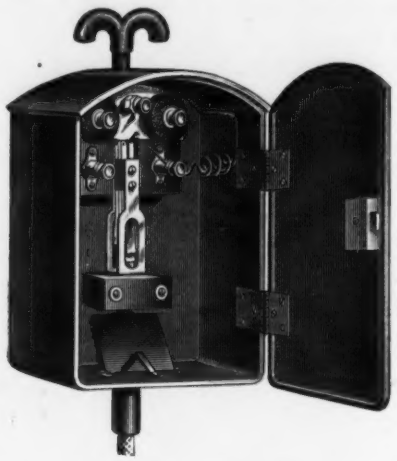


FIG. 3.—CUT-IN STATION.

sleeve for plug guide, the tension of the springs being sufficiently strong to retain the plug firmly in position and assuring perfect electrical contact. On the bottom of the box, there is a "Y" shaped groove which forms a path for the plug to the opening in the spring jack sleeve, thus making it convenient for the user to insert plug into the jack. The mere insertion of the plug calls headquarters.

This instrument bids fair to become a very popular instrument with street railway people and it is understood that the Stromberg-Carlson Company has a number of contracts already executed for this line of apparatus.

Indicator "Take-Up" Device.

A trouble experienced in using the detent on the steam engine indicator lies in the slack given up by the cord between the paper drum and reducing bushing on wheel. This slack, if not properly guided, when throwing on the detent, is liable to get foul, thereby in many instances wrecking the instrument or at least breaking the cord, thus causing delay and inconvenience to the operator. The take-up device here shown is for the purpose of doing away with this annoyance. It is simple in its construction and can be applied to any standard indicator.

It consists of a short horizontal arm, at one end of which is a vertical bearing, in which sets a steel pillar on the upper end of which there is a frame holding a double set of loose steel pillars, and between these the cord from the paper drum passes. On the lower end of the vertical pillar there is a light spiral spring enclosed. This spring causes the upper frame to revolve when the cord becomes slack, and is so arranged that the cord winds on the frame, to be given up again when the tension is applied.

The object of the device is to permit the operator to take as many cards as desired without unhooking from the crosshead or stopping the engine, no matter what speed. This, of course, pertains to indicators that are fitted with a detent and using a direct-connected reducing motion, the latter being by long odds the most popular in modern engineering practice.

Where an indicator is used in connection with a pendulum, lazy-tongs or reducing motion attached to the engine frame there is less trouble, and generally a rubber band is employed to take care of the slack cord, which works fairly well. In this case the take-up device is in the shape of a regular guide pulley to connect direct to the indicator; the guide pulley is removed and this put in its place and wound up, when it is ready for use. It can also be used with satisfaction as a guide pulley if not needed to take up slack cord, as the little pulleys are arranged to let the cord run through with perfect freedom. Immediately the detent is engaged it picks up instantly what slack

INDICATOR "TAKE-UP" DEVICE.

cord there is. The tension of the spring in this device being so much weaker than the drum spring, as soon as the detent is disengaged the cord is instantly released, drawn out taut and assumes its regular position. The take-up device may also be attached to an engine frame and used in various other ways. It works at any number of revolutions and is designed to fit all standard indicators and reducing wheels, or it can be made as a special fixture. The manufacturers are James L. Robertson & Sons, 204 Fulton Street, New York.

Electricity in a Temporary Ball Room.

The handiness and flexibility of the Elblight system of electric lighting cables and signs have already been brought to notice in these columns. A recent pretty illustration of these features was afforded

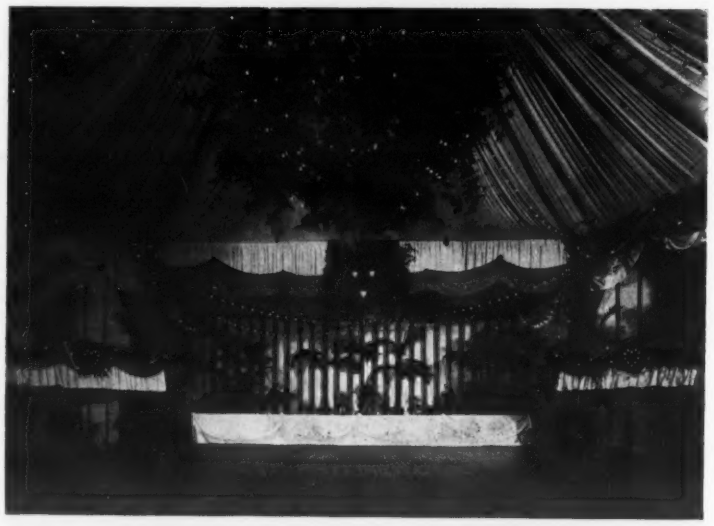


FIG. 1.—ILLUMINATION OF BALL ROOM.

by the ball given at Morristown, N. J., by President McCurdy, of the Mutual Life Insurance Company, of New York City, when the appliances of the Elblight Company of America were freely availed of for

the swift accomplishment of a large amount of necessary work. The entire parquet floor of the Morristown Lyceum was floored over and carpeted for dancing. The flooring had been laid over the seats, and on a level with the stage. The entire hall resembled a miniature fairy-land, with varied lights, 4,500 in number. These were all incandescent lamps, and were red and yellow. The large chandelier in the centre

FIG. 2.—EXTERIOR ILLUMINATED DECORATIONS.

of the hall was decorated in two shades of yellow, and was a mass of incandescent lamps. Across the entire ceiling there were rows of red and yellow lights. Outside the building there were about 700 incandescent lights, white. It is obvious that with the ordinary appliances such preparations for lighting would take weeks instead of occupying but a day or two.

A Novel Application of Electric Sign Flashers.

The use of flashers for switching on and off electric signs for advertising purposes in out-door work is becoming very common. It has not, however, been extensively applied to interior decorative lighting. An interesting installation of this kind is being made in the barroom of the Brevoort House, Chicago. The lighting of this expensively fitted up room is done entirely by lights so placed that no direct rays from the lamps meet the eye, save those from a few lamps used for illumination purposes in the lower part of the room. The ceiling decorations are brought out entirely by concealed lights.

The idea carried out here is to have a change of color in the ceiling decorations every few seconds, there being four colors, green, white, red and yellow. The original installation had provision for changing these colors by rotating a glass disk with the various colors upon it in front of the lights. Each glass disk was rotated by a ratchet and pawl, worked by an electro-magnet. The magnets were connected in series and operated simultaneously. This apparatus was never satisfactory, as there were about 70 of these electro-magnetic mechanisms to be taken care of, and if some of them failed to work part of the time, the colors would get out of step, so that instead of showing variously colors simultaneously, some light would be one color, some another.

After a large expenditure of time and money in experimenting with these devices, they were abandoned, and the work is now being done very simply and easily by the use of a sign flasher, made by the Reynolds Electric Company, of Chicago. The change of color is obtained by switching on and off lamps of different colors in each group. A group consists of four lamps, each a different color and each wired to a separate circuit. It is, therefore, a very simple matter to connect the flashers so as to light alternately the green, red, yellow and white lamps.

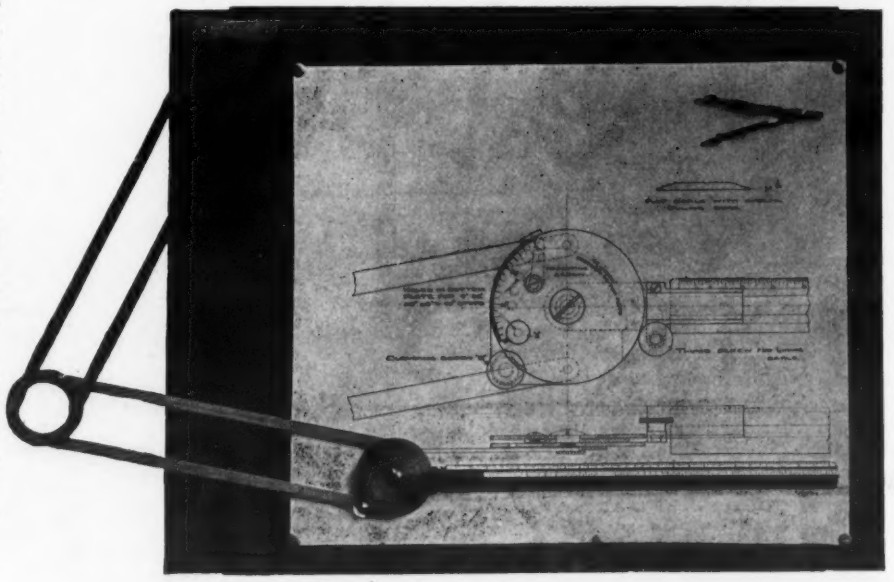
Mechanical Draft Plant for St. Louis Fair.

The mechanical draft feature of the Union Electric Light & Power Company's plant, which will be used for lighting the World's Fair grounds at St. Louis, will be an installation of unusual interest to engineers. The plant is to be equipped with both forced and induced draft apparatus, which is unusual. A mechanical draft plant usually is either of the forced or induced draft type, but in this case both will be used. There will be 26 boilers of 700 hp each, and all equipped with automatic stokers. Fans will be used for forced draft, and the boilers will also be operated under induced draft. The forced draft fans will be four in number, of the full housing type, size 160 inches. They will be driven by 10 x 10 vertical engines direct attached. The induced draft fans will be two in number of a size quite in keeping with the scope upon which the Exposition is being built, the wheel diameters being so large as to be seldom met with in mechanical draft engineering. Each of these induced draft fans will be of the full housing type, size 230 inches, and will be driven by 9 x 10 double cylinder, double-acting upright engines, this type being selected to secure the maximum power in limited space. The Buffalo Forge Company is building all the fans and engines for the above equipment.

Rapid Sketching Device.

The sketching device illustrated herewith is a convenient instrument for making rapidly sketches or small drawings. It is claimed to be particularly adapted to designing, as it obviates attention to the tools, thus allowing the mind to remain concentrated upon the design. The device consists of a scale joined to a protractor which is anchored to the upper left hand corner of the board by means of an arm made up of two pivoted parallelograms.

The scale has a free motion of 90° between two stops, and it comes against either one or the other, depending upon whether a horizontal line or a vertical line is desired. These two stops are fastened to a protractor and may be turned to any angle with the horizontal or vertical, thus permitting the scale to come against a stop at the desired angle and also at right angles to it. The lower part of the protractor always lies in the same direction no matter where it is moved about the board, and hence when the protractor is once set at any desired angle the scale will give parallel lines anywhere on the drawing. This is accomplished by the two parallelograms, which act similarly to a parallel ruler.



SKETCHING DEVICE.

The protractor may be clamped at any angle by means of the thumb screw, *B*. A spring stop, *A*, is provided for the 0°, 30°, 45°, 60° and 90° angles, and is operated by merely raising it and allowing it to drop into the hole for the angle desired. The screw *C* is for adjusting the right angle stops. The instrument is made by the Universal Drafting Machine Company, Blackstone Building, Cleveland, O.

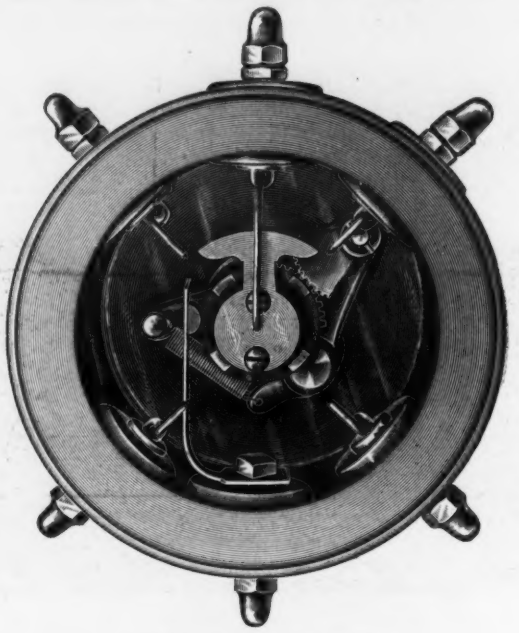
Improvements in the "Hylo" Lamp.

The growing popularity of regulating incandescent lamps, whose light can be raised or lowered at will, without extinction, is attested by the success of the Phelps Company, of 41 State Street, Detroit, Mich., whose two-filament lamp with socket contacts for changing the candle-power, is familiar to all our readers. It will be recalled that in one position the full candle-power filament is in circuit, and that in another position the low-candle-power filament is cut in and its companion is cut out. To meet objections that might be made to the looseness of the lamp in the socket on account of the spring lamp base, the Phelps Company have added to their productions a most handy and ingenious "Hylo" in which the lamp is associated with a short, flexible cord, and makes a firm seat in the socket, as shown in the illustration below.

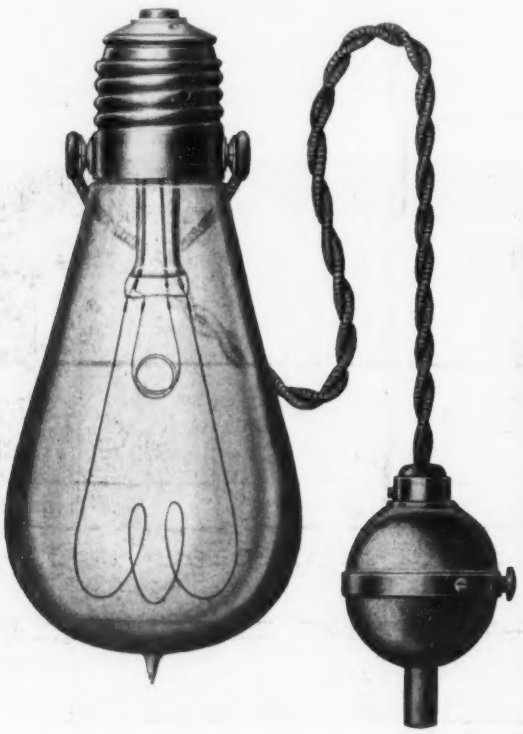
The cord carries the connections for the two filaments to a neat, small "push" in highly finished nickel and hard rubber. At the base of the push is the switch, which, on being pressed, throws in the full-power filament. At the side is a corresponding switch, which cuts out the full filament and throws in the lower power. The push switch is so connected up that the operation of each switch cuts out the other with a sharp snap, and the whole arrangement is of fire-proof construction, carefully designed to meet the underwriters' requirements. The red silk cord and the nickel push are quite ornamental, and the whole appliance is such as to win hearty approval as well as general adoption. Once the public or the individual becomes accustomed to the convenience of the dimming facilities of such lamps, they will always remain in high favor; and this new device is an additional recommendation for them.

The King Automatic Timing Device.

A novel compact timing device for gas engines is the King automatic timing device. This apparatus times automatically the point of ignition, thus always giving the maximum power in the engine. A throttle-valve on the engine, controlled by the operator, acts indirectly upon this governor, as the speed is varied. The attention of the operator in controlling an extra lever is not needed, and the many bad combinations possible with the hand-controlled lead and throttle are thus avoided. An engine that has shown lack of power will prove itself equal to the occasion with one of these timing devices. Its power it built up automatically with each stroke of the engine. The visible spark feature is worthy of notice, as at a glance the driver can see if each cylinder is working properly; or, if one is causing trouble, it can be instantly detected and corrected. This timing device is ornamental and is arranged to be placed on the dash; it can, however, be connected to any part of the engine. The case being covered with a glass, it is dust and fool proof, and requires practically no attention. The complete weight is about four pounds. This device is the invention of Charles B. King, and is fully protected by patents. It is manufactured and sold by the Dayton Electrical Mfg. Co., of Dayton, Chio, manufacturers of the Apple igniter, so well known in automobile and other hydrocarbon engine uses.



AUTOMATIC TIMING DEVICE.



"HYLO" LAMP.

A Large Automobile.

We illustrate herewith one of the largest and most powerful automobiles so far built in this country. This machine has a four-cylinder 30-hp gasoline engine placed in front underneath the metal hood.

The method of ignition is by means of the electric jump spark system, and four induction coils are used with a contact box which makes and breaks the primary winding of the coil. From center to center of axles is 10 feet 4 inches, and the weight is 3,400 pounds. It will carry six people in the rear and three on the front seat. The rear seats are detachable. This machine is very fast and has made a mile in 1.20 on a round track under unfavorable conditions. It is owned by A. L. Dyke, the pioneer auto parts and electrical supply dealer of 1402 Pine Street, St. Louis. Mr. Dyke made the machine up for his own use.

LARGE AUTOMOBILE.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was firmly held, with a fair demand. The closing rates were 6 per cent. for 60 to 90 days, 5½ a 6 per cent. for 4, 5 and 6 months. The stock market was narrow, public participation being slight. The expectation of continued firmness in money restricted active operation, and some attention was paid to the prospects of Congressional action for the regulation of "trusts," industrials being dull and heavy. The announcement of the Manhattan lease was a leading incident in the market, and this stock was the leader in point of activity. The other tractions sold off when it became definitely known that neither Metropolitan nor Brooklyn Rapid Transit would participate in the deal, but the latter was very strong on Friday, closing on Saturday at 63⅞, a net gain of 1¾ points. It reached as high as 65¼, the transactions for the week aggregating 92,475 shares. Metropolitan closed at 139⅞, being a net loss of ¼ point. The highest figure of the week was 142¼ and the lowest 138½. Manhattan Elevated ranged between 149¾ and 158, closing at 156½, representing a net gain of 5½ points over our last previous quotation. General Electric was quiet, only 2,000 shares having changed hands. The closing quotation was 179, being a net loss of 1 point. This was also the lowest price, the other extreme being 180—a range of only one point. One hundred shares of Westinghouse common sold at 206, a net loss of 1 point; the preferred closed at 208, being a net gain of 4 points. Western Union lost 2 points, closing at 88, after having reached 89¾. American Telegraph & Telephone closed at 161, a loss of 1 point. In Boston, General Electric made a gain of 1½ points, as compared with the last previous prices. Following are the closing quotations of December 3:

NEW YORK.

	Nov. 25.	Dec. 2.		Nov. 25.	Dec. 2.
American Tel. & Cable..	—	89	General Electric	180	177
American Tel. & Tel...	159	159	Hudson River Tel.....	—	—
American Dist. Tel.....	—	35	Metropolitan St. Ry....	139	141½
Brooklyn Rapid Transit.	61¼	64⅝	N. E. Elec. Veh. Trns..	5/16	⅛
Commercial Cable	—	170	N. Y. & N. J. Tel.....	164	162
Electric Boat	20	20	N. Y. E. V. T. Co....	11½	—
Electric Boat pfd.....	37	37	Tel. & Tel. Co. Am....	—	—
Electric Lead Reduc'n..	3½	3½	Western Union Tel.....	88⅛	87¾
Electric Vehicle	4	4	Westinghouse Com.....	200	200
Electric Vehicle pfd....	10	11	Westinghouse pfd.....	206	205

BOSTON.

	Nov. 25.	Dec. 2.		Nov. 25.	Dec. 2.
American Tel. & Tel..	160⅞	160¾	Western Tel. & Tel. pfd	98	—
Cumberland Telephone .	126	—	Mexican Telephone	2	2
Edison Elec. Illum.....	—	—	New Eng. Telephone...	138	137
General Electric	—	178½	Westinghouse	100	101
Western Tel. & Tel....	25	—	Westinghouse pfd	100	102

PHILADELPHIA.

	Nov. 25.	Dec. 2.		Nov. 25.	Dec. 2.
American Railways.....	—	52¾	Phila. Traction	98	97¾
Elec. Storage Battery...	80	79	Phila. Electric	9	8¾
Elec. Storage Bat'y pfd	—	—	Pa. Elec. Vehicle	—	—
Elec. Co. of America...	9¼	9½	Pa. Elec. Vehicle pfd..	—	—

CHICAGO.

	Nov. 25.	Dec. 2.		Nov. 25.	Dec. 2.
Central Union Tel.....	—	—	National Carbon pfd....	—	100*
Chicago Edison	—	175	Northwest Elev. Com..	—	—
Chicago City Ry.....	211	211	Union Traction	15	14¼
Chicago Tel. Co.....	160	—	Union Traction pfd...	45	45
National Carbon	—	30*			

* Asked.

MANHATTAN ELEVATED.—The directors of the Manhattan Elevated Railway Company have voted a quarterly dividend of 1½ per cent. on the stock, payable January 2d next. This is an increase of one-half per cent. from the late quarterly dividends of the Manhattan Company. The elevated railway has paid at the rate of 4 per cent. annually since the first quarter in 1897. From 1891 to 1896, inclusive, it paid 6 per cent. annually; the subsequent reduction being due to the great loss in earnings, after 1896, through diversion of traffic to the street-car lines. In the few years prior to 1891, the dividend was uncertain, owing to the damage suits of abutting property. The Manhattan Elevated directors have called a shareholders' meeting for January 16, to vote on the plan to increase the company's capital stock from $48,000,000 to $60,000,000. Of this new stock, 72,000 shares are to be issuable as soon as authorized, and the remaining 48,000 shares to be issued at some future time, not, however, prior to January 1, 1906. The circular adds: "The purpose of so increasing the capital stock of the company is to provide the additional funds needed to complete the contemplated improvements in the structure, equipment, and property of the Manhattan Railway Company, including the cost of substitution of motive power, new plant and equipment, additional yard facilities, purchase of real estate and interests therein connected with the right of way of the company, and other necessary requirements in the construction, maintenance, and operation of the railways of this company properly chargeable to capital account." The increase in stock was provided for by the terms of the lease of the Manhattan to the Interborough Company. The last increase in the company's capital was in March, 1899, when $18,000,000 was sold to meet the cost of the proposed electrical equipment.

BOSTON ELEVATED.—The annual report of the Boston Elevated Railway Company for the year ended September 30 has been filed with the Railroad Commissioners. Compared with previous years the figures are as follows:

	1901-2.	1900-1.
Gross	$11,321,030	$10,792,993
Operating expenses	7,862,571	7,336,597
Net	3,458,459	3,456,396
Other income	.....	76,503
Total net	3,458,458	3,532,899
All charges.....	2,836,560	2,896,359
Balance	621,898	636,530
Dividends	600,000	575,000
Surplus	21,898	61,539

In 1899-1900 the gross earnings were $10,141,209, and in 1898-9 they were $9,671,440. The number of revenue passengers carried was 222,484,811, against 213,107,600 last year. There are 7,166 employes and 2,187 stockholders.

BELL TELEPHONE OUTPUT.—The American Telephone & Telegraph Company instrument statement for the month ended November 20 and since Dec. 20 shows:

	1902.	1901.	Changes.
Gross output.....	93,487	88,497	Inc. 4,990
Returned	36,838	27,510	Inc. 9,328
Net output.....	56,649	60,987	Dec. 4,338
Since December 20:			
Gross output.....	994,422	867,323	Inc. 127,099
Returned	420,682	352,173	Inc. 68,509
Net output.....	573,740	315,150	Inc. 58,590
Total output.....	3,099,316	2,467,966	Inc. 631,305

DIVIDENDS.—The directors of the South Side Elevated Railroad, Chicago, have declared a quarterly dividend of 1 per cent., payable December 31. The directors of the Massachusetts Electric Co. have declared a semi-annual dividend of 2 per cent. on the preferred stock. The Philadelphia Electric Co. has declared a dividend of 18¾ cents per share. This is 3¾ cents more than the company's first payment, but directors of the company say that there is practically no change. It is argued by some of them that the first dividend was when $6.25 had been paid in upon each share, and was virtually at a 5 per cent. rate, being 2½ per cent. on $6. In the official statement the present dividend was said to be at the rate of 5 per cent. on $7.50 paid.

STANDARD TELEPHONE COMPANY.—A special dispatch from Atlanta, Ga., of November 29 says: "Application was made to Judge Newman in the United States Court this morning for a decree for the sale of the property of the Standard Telephone Company under a mortgage given to the City Trust Safe Deposit and Security Company of Philadelphia to secure an issue of $550,000 worth of bonds. Judge Newman, after hearing argument in the case, said he thought the property ought to be sold, but that he would not sign an order until next Saturday in order that the attorneys for intervening bondholders who resisted the decree might have time to reach an understanding as to terms.

COLORADO SPRINGS MORTGAGE.—The Colorado Springs & Cripple Creek District Railway Company (electric) has filed a mortgage with the Morton Trust Company to cover an issue of $3,600,000 5 per cent. 40-year gold bonds to take up its first and second mortgage bonds and provide $1,600,000 for new work.

KEYSTONE TELEPHONE.—It is announced that the $2,500,000 unissued preferred stock of the Keystone Telephone Company will not be issued, but that a loan probably not to exceed $2,000,000 will be negotiated to complete the company's equipment in Philadelphia.

ALLIS CHALMERS.—The Allis Chalmers Company stock has been listed on the New York Stock Exchange consisting of $16,250,000 7 per cent. cumulative preferred stock, and $20,000,000 common stock.

Commercial Intelligence.

THE WEEK IN TRADE.—The mild weather is affecting distributive trade somewhat, but general industry is active all over the country, manufacturers and producers being still urgently pushed to deliver on orders booked some time ago. Improvement is noted in the transportation congestion, but the car shortage is still a cause of worry to railroad managers and merchants alike. Lower prices for cereals, provisions and finished iron and steel give hope for better export trade and the possibility of cutting down some of the unfavorable foreign trade balance shown early this year. Collections are still good in a majority of cases; money tends towards greater ease, but the return of currency from the country is slow. On the Pacific coast, trade is very active, and from the South come good reports, except Texas, where two weeks' rain has hurt the cotton crop and business and delayed collections. At the East a satisfactory condition of trade prevails generally. In the iron trade there is a more cheerful sentiment; finished products are firmer in tone. Among the other metals, copper is weaker in tone, and tends downward on increased offerings and weak foreign markets. One million pounds of December electrolytic was offered at 11.25c., but no bid higher than 11c could be obtained. The closing quotations were: 11.25 a 11.50c. for Lake; 11.12½ a 11.25c. for electrolytic and casting stock, and 10.50c. for Standard. According to *Bradstreet's*, the number of business failures during the week ended November 27 aggregated 182, as against 201 the previous week and 189 the same week last year.

EQUIPMENT FOR BIG INDIAN POWER PLANT.—The Cauvery Falls power transmission plant, which is equipped with American electrical machinery, and whose present capacity is about 4,000 hp, is to be extended to 10,000 hp, and Major A. C. Joly de Lotbiniere, the deputy chief engineer of the Mysore government, is now here with a view to making the necessary purchases. The plant, which began active operations June 30 last, generates power for the purpose of operating the gold mines in the Kolar district, India. Prior to utilizing electricity, steam power was employed to work the Kolar fields, the cost being $155 per horse-power. The present power is sold at $145 for the first year. For the second, third and fourth years the charge will be but $90 per horse-power. For the fifth year the price will not exceed $120, while the five years following power will be delivered to the mining interests at $50 per horse-power. It is estimated by the engineers that the higher charges made during the first five years besides making full provision for the working expenses and repairs will enable the Mysore government, which operates the plant, to compensate itself for the capital outlay which before the system is completed will entail an expenditure of some $6,000,000. The transmission line is the longest in the British Empire. The distance over which the power is transmitted before any motors are attached to the lines is 92 miles, and after reaching the goldfields the length of the distributing systems places the farthest motor considerably over 100 miles from the source of power. The General Electric Company filled the contract for the electrical portion of the system, Mr. Axel Ekstrom of the company being the chief engineer in charge of the construction work. There are six generators of 720-kw capacity each, 2,200 volts; two exciters of 75 kw each, direct-connected to dynamos; 12 transformers of 400 kw each, and several motors, mostly induction, varying from 4 hp to 400 hp and averaging 130 hp each. The labor arrangements are such that there is a continuous load for practically the whole 24 hours. One of the main generators is kept in reserve. The turbines are of Pelton type, built by the Swiss firm of Escher, Wyss & Company, of Zurich. There are six machines of 1,250-hp capacity each working with an effective head of 382½ feet. Two smaller wheels drive the exciters. The power operates mines where 25,000 men are employed, 14,000 of whom work underground.

H. B. COHO & COMPANY, INC., general sales agents of the Keystone Electric Company, report recent sales of Keystone generators and motors to the following customers: American Hard Rubber Company, Butler, N. J., one 50-hp motor, one 10-hp motor; Ball Engine Company, Erie, Pa., ten motors; Carnegie Coal Company, Carnegie, Pa., one 175-kw generator, with switchboard; Clemson Bros., Middletown, N. Y., one 10-hp motor; Erie City Iron Works, Erie, Pa., one 67-hp motor; Erie Forge Company, Erie, Pa., one 25-kw generator; Fischer Motor Vehicle Company, Hoboken, N. J., one 5-kw generator; Franklin Supply Company, Franklin, Pa., one generator; Herbert Manufacturing Company, Erie, Pa., one 15-kw generator; Jones Bros., proprietors Grand Union Tea Company, Brooklyn N. Y., one 30-hp motor, one 20-hp motor, one 15-hp motor, one 10-hp special motor, two 5-hp motors, one 7.5-hp motor; Leggett Bros., New York, N. Y., one 3-hp motor; W. C. McIntire & Company, Philadelphia, Pa., one 200-kw generator; Malleable Castings Company, Sharon, Pa., one 5-hp motor; Mansfield Coal Co., Carnegie, Pa., one 150-kw generator; Masurite Explosive Company, Sharon, Pa., two 8.5-hp motors; Penn Boiler Works, Erie, Pa., one switchboard; J. C. Stearns, Buffalo, N. Y., one 5-hp motor; Union Ice Company, Erie, Pa., one 30-kw generator; United States Mint, Philadelphia, Pa., five special vertical motors; H. F. Watson & Company, Erie, Pa., one 25-kw generator; Watson & Stillman, one 18.5-kw generator; A. C. Welchans, Lancaster, Pa., two 85-kw generators with switchboard and motors.

THE NORTHEASTERN TELEPHONE COMPANY, of Portland, Me., has placed an order with the Automatic Electric Company, Chicago, for a switchboard and telephones for the new exchange, which will be built in the city of Portland. The switchboard will have a capacity of 10,000 stations with 2,500 connected up in the beginning. A building site has been purchased in the heart of the city, and the architects are now in correspondence with the engineers of the Automatic Elctric Company to the end that the exchange building shall be best suited for the automatic system. The Northeastern Company proposes to install a model plant. All outside work will be of the most modern type; in the business part of the city all cable will be placed underground, and the aerial work will be of the most durable character. Within a radius of one and one-half miles of the exchange there is a population of 40,000 people. The promoters of this enterprise believe that as soon as their exchange is in working order and the people are familiar with the service, the number of subscribers will be rapidly increased to 3,500 or 4,000.

HEINE BOILER ORDERS.—The Heine Safety Boiler Company, of St. Louis, whose New York offices are in the Bowling Green Building, has just secured a contract from Cerveceria Cuauhtemac, Monterey, for the shipment of two boilers of 250-hp capacity each, for installation in an electric plant in that Mexican city. Among recent domestic orders is one for 1,050 hp in three units for the big new India Building, Boston, Mass., where the equipment will be utilized in connection with a large lighting and general power plant. The Reading Cement Company, of Reading, Pa., which concern is building an extensive plant, to be electrically operated, has ordered two 350-hp Heine boilers. The Jennings Electric Light & Power Company, of Jennings, La., has contracted for the supply of a 250-hp boiler. The Utah Electric Light & Power Company, of Salt Lake City, Utah, has also ordered a Heine boiler of similar capacity, and the Philadelphia & Lehigh Valley Traction Company has requisitioned for 300 hp outfit for installation in its Ambler, Pa., plant.

STOREY MOTOR GROWTH.—The Storey Motor & Electric Company, of Harrison, N. J., of which Mr. Henry E. Fanshawe was recently elected a director, is pushing matters actively. Its manufacturing department has been placed under the care of Mr. Thos. J. Fay as general manager, he having resigned from the C. W. Hunt Company. Mr. C. H. Shum, formerly of the La Roche Company, of this city, and the Bergmann Works in Germany, has been appointed as electrical engineer. He is a Cornell graduate of 1895 and well posted. The company has increased its machine tool equipment and is experiencing an excellent demand for its product, orders being many times greater than last year. The company are paying special attention to variable speed motors for direct-driven tools, and in this field their contracts are already abreast of their capacity for several months to come.

THE WAGNER-BULLOCK ELECTRIC COMPANY has closed a contract with the Stuparich Manufacturing Company to install a complete plant for the electrical operation of its large photographic-mount factory in San Francisco. A number of direct-current motors will be direct-connected to the various machines. The whole plant will be operated under the system upon which the Bullock Electric Manufacturing Company holds patents. A 50-kw generator, belted to a 100-hp Nordberg-Corliss engine, will supply current for the operation of the motors.

GOVERNMENT CONTRACTS OPEN.—Proposals will be received until Saturday, December 20, for furnishing engines, generators, boilers, etc., for a complete electrical power plant for the Frankford Arsenal, Philadelphia, Pa. Major Frank Heath is in charge of the work. Proposals will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until December 16 for the navy yard, Mare Island, Cal., for a quantity of transformers, electric cable, etc., for the training station, San Francisco, Cal.

GATES AFTER BARBADOES LIGHTING CONCESSIONS.—Franchises are being sought with a view to the construction of plants to light the principal towns in Barbadoes, British West Indies. It is reported that parties are now on the spot in the interests of John W. Gates and his friends. Two of the towns from which concessions are sought are Bridgetown, having a population of about 22,000, and Sperghstown, which has about 2,000 inhabitants.

CONTRACTS PENDING FOR NICARAGUAN ROAD.—Contracts are about to be let by T. H. Davis, the manager for an electric road in Rivas, Nicaragua, which is styled the Compania de Tranvia de Rivas. Rivas has a population of about 9,000.

ELECTRIC TRACTION FOR GRANADA.—The Compania de Tranvias de Granada, of Granada, Nicaragua, is to be converted from a horse to an electric road, and will be considerably extended.

MESSRS. QUEEN & COMPANY, Philadelphia, sold recently to a representative of the Japanese Government one of their X-ray machines for a rather novel purpose. The government representative who placed the order explained that in the governmental mints in Japan they coin a great many gold dollars, and the government has suffered considerable loss in the past through dishonest employees swallowing gold dollars and carrying them out of the mint "in their little insides." The X-ray apparatus will be used to examine employees as they depart from the mint daily, and will, of course, reveal the presence of any dollars which may be in the man's stomach at the time. It is not proposed to put every employee through this examination each time he leaves the mint, but it will be done from time to time, unexpectedly, and any employee will be liable at any time to be called up for the X-ray examination. In this way the government hopes to inculcate in its employees the fear of detection which will prevent the form of theft referred to. Possibly the same ingenious idea could be applied in South Africa to diamond stealing by the black laborers at the mines.

DEVELOPMENT AT CORSICANA, TEX.—The Corsicana (Tex.) Gas & Electric Company is installing a new plant. The system is to be three-phase alternating-current, the arc lights to be run from the main three-phase generators through series transformers and of the enclosed arc type. There will be three 150-kw three-phase 2,300-volt generators direct-connected to tandem compound automatic engines of 225 hp each, three 175-hp water-tube boilers, feed-water heaters, etc., entirely new. The electrical apparatus will be furnished by the General Electric Company, the engines by the Russell Company, of Massillon, Ohio, and the boilers by the Stirling Company, of Barberton, O. The entire lines over the city are being reconstructed with new poles and new copper. Mr. F. N. Drane, the present manager of the Corsicana Gas & Electric Company, is actively engaged developing the new plant.

MORE NIAGARA POWER.—A new factor in the power development at Canadian Niagara has presented itself by the application of a new syndicate for a franchise to develop power in Victoria Park. To all indications this latter company aims to be thoroughly Canadian, for it is to be organized by Canadians, Canadian capital is to be used, and the power is to be sold in Canada for use by Canadians. This is the substance of a statement made by Frederic Nicholls, director of the Canadian General Electric Company, who is interested in the syndicate, as is also William Mackenzie, president of the Toronto Railway. The application is being considered by the government and the park commissions. If granted, it is understood the company would erect a power station at the water's edge in the gorge below the prospective plant of the Ontario Power Company.

TO BUY EQUIPMENT FOR MEXICO.—Mr. Harold J. Ross, of the City of Mexico, is now in New York for the purpose of letting contracts for the equipment of an electric transmission plant near the town of San Martin, Texmelucan, in the State of Puebla, Mexico. It is proposed to utilize the power of a large waterfall on the hacienda owned by Monseñor Guillow, the archbishop of Oaxaca. The initial capacity of the plant will be 500 hp. The power will be transmitted to Texmelucan, which is situated about 10 miles distant. The energy will also be used to operate cotton mills and other industrial plants in the vicinity. Later on a larger amount of power will be generated for transmission to Tlaxcala and to the haciendas located between San Martin, Texmelucan and the city of Puebla.

APPARATUS FOR BRITISH COLLIERIES.—American electrical machinery is to be installed on an extensive scale in several of the more important English and Welsh collieries, contracts having lately been closed with the Westinghouse interests, which will represent an expenditure of considerably over $1,000,000. The principal contract calls for a 4,000-hp plant to be erected in the collieries of the Staveley Coal & Iron Company, of Chesterfield, English Midlands. Another important contract has been secured from the Sneyd Colliery Company at Burslem, Staffordshire, where a 1,500-hp equipment will be utilized. The Byers Green Colliery, at Auckland, north of England, will also have an extensive American electric coal-cutting equipment.

MORE NIAGARA POWER.—A new factor in the power develop- of the City of Mexico, has acquired a concession for the purpose of constructing a hydraulic plant on the River Atoyac, located near Cordoba, in the State of Vera Cruz. The franchise permits of the utilization of 11,000 liters per second. All the material, etc., rendered necessary for the construction and equipment of the plant is to be admitted into Mexico free of duty. Thomas Braniff, Jr., also of the Mexican capital, has secured a concession for the erection of a water power plant on the River Blanco, located in the Canton of Orizaba, in the State of Vera Cruz. The concession provides for the use of 29,000 liters of water every second.

MACHINE TOOLS FOR SOUTH AFRICA.—Young & Park, Inc., of 45 Broadway, New York, are at present filling some fair-sized contracts for machine tools, etc., for shipment to South Africa. Through this firm, Wm. Sellers & Company, of Philadelphia, have secured an order for planers, the Hendley Machine Company, of Torington, Conn., is furnishing large lathes, the J. A. Fay & Egan Company, of Cincinnati, O., have got orders for wood working machinery, etc., and Cox & Sons, of Philadelphia, are about to make shipment of some screwing machines. Young & Park are now figuring on some large lots of centrifugal pumps for shipment to Johannesburg.

ELECTRICAL GOODS FOR EGYPT.—Mr. Selim Chaker, of Cairo, Egypt, who handles American machinery for the Egyptian, Soudanese and Palestine markets, is now in the United States. He has placed a large contract with the Elliott & Hatch Book Typewriter Company, of 256 Broadway, New York, for machines which will write in Arabic characters. Mr. Chaker is on the lookout for electrical goods, etc. He is a guest at the Stevens House, 27 Broadway. According to present arrangements, he will be here for a month at least.

THE BOSTON TELEPHONE SELECTOR COMPANY has incorporated under the laws of the State of Maine, to manufacture the Mayberry-Holmes party line system. The offices of the company are at 183 Essex Street, Boston, and its officers are as follows: Watson M. Holmes, president; F. E. Mayberry, vice-president and electrician; N. L. Johnson, secretary and treasurer. This company has recently equipped an exchange at Hoosick Falls, N. Y., with a 250 line capacity, 120 lines of which are installed.

CONTRACTS FOR JAPANESE PLANTS.—Some very important contracts for electrical equipment, etc., will be placed within the next few days, in connection with Japanese electric traction and lighting projects, by Mr. A. L. Bagnall, of the American electrical engineering and contracting firm of Bagnall & Hilles, of Yokohama, who has just arrived in New York. Mr. Bagnall is making his headquarters at the offices of the New York Insulated Wire Company, 114 Liberty Street.

THE MECHANICAL BOILER CLEANER COMPANY, manufacturers of the Garrigus mechanical boiler cleaner, reports an order just received for eleven cleaners from the Milwaukee Electric Railway & Light Company. This is the fourth order received from that company, and is a favorable indication of the merit of this invention. Mr. W. R. Mason is the sales manager for this company, with offices at 413 Western Union Building, Chicago.

NEW MANHATTAN CARS.—The Manhattan Railway Company has closed a contract with the Wason Manufacturing Company, of Springfield, Mass., for sixty cars of a new type. They are to be much heavier than those now in use in the company's lines and will be equipped with Westinghouse air brakes. This contract is entirely independent of the order for 250 cars upon which the Wason Company has been at work for several months.

TUXEDO LIGHTING PLANT.—The New York electrical engineering and contracting firm of Sanderson & Porter have been commissioned by the Tuxedo Electric Light Company, of Tuxedo, N. Y., to draw up plans for an extension of the company's plant. The present equipment consists of Babcock & Wilcox boilers, General Electric Company's belted generators and Fishkill tandem compound condensing Corliss engines.

DURBAN ROAD TO BE EXTENDED.—The Durban municipal electric traction system, which is mostly operated with American equipment, is to be extended from that South African city to Sydenham, one of the old suburbs. The British electrical engineering and contracting firm of Macartney, McElroy & Company, Limited, whose New York offices are in the Havemeyer Building, is reported to be after the contract.

WATER-POWER PLANT TO LIGHT AMECA, MEXICO.—Contracts are shortly to be let for the equipment of a hydraulic plant, which is to be constructed on the hacienda de la Estaizuela in the State of Guadalajara, Mexico, for the purpose of generating and transmitting energy to light the city of Ameca, which place has a population of about 12,000. The transmission line will be about 10 miles in length.

SEPARATORS FOR JOHANNESBURG ELECTRIC PLANT.—The Goubert Manufacturing Company, whose offices are in the Singer Building, Liberty Street and Broadway, has secured a contract from Young & Park, Inc., whose offices are in Aldrich Court, 45 Broadway, for two large separators, to be installed in an electrical plant now under construction in Johannesburg, South Africa.

ANOTHER MEXICAN ELECTRIC TRACTION PROJECT.—It is proposed to convert the horse tramways in the city of San Luis Potosi, Mexico, into an electric traction system. The existing lines are about 13 miles in length. The equipment, etc., will be purchased in the United States.

LARGE LONDON PUMP CONTRACT.—William E. Quimby, Incorporated, is figuring on a big contract for pumping equipments, intended to be installed in a large electrical plant in the British metropolis.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical material and machinery from the port of New York for the week ended November 15: Argentine Republic—20 pkgs. material, $195. Antwerp—36 pkgs. material, $2,549; 1 pkg. machinery, $62. Berlin—8 pkgs. machinery, $577. Bristol—3 pkgs. machinery, $160. British East Indies—2 pkgs. machinery, $58. British Australia—69 pkgs. machinery, $3,777; 38 pkgs. material, $2,231. British Possessions in Africa—23 pkgs. material, $1,970. British West Indies—14 pkgs. material, $294. Central America—18 pkgs. material, $699. Cuba—41 pkgs. material, $449. Canary Islands—3 pkgs. material, $60. Chili—60 pkgs. material, $1,472. Dutch East Indies—1 pkg. material, $15. Ecuador—2 pkgs. material, $23. Genoa—12 pkgs. machinery, $600. Hamburg—12 pkgs. machinery, $900; 29 pkgs. material, $3,561. Havre—14 pkgs. material, $337. Liverpool—272 pkgs. machinery, $25,089; 32 pkgs. material, $2,150. Leeds—3 pkgs. material, $104. London—119 pkgs. machinery, $2,619; 81 pkgs. material, $6,489. Lisbon—1 pkg. material, $8. Mexico—232 pkgs. material, $2,526; 1 pkg. machinery, $2,160. Nova Scotia—14 pkgs. machinery, $523. Newfoundland—2 pkgs. material, $83. Rotterdam—16 pkgs. machinery, $686. Southampton—22 pkgs. material, $2,023. San Domingo—72 pkgs. material, $508. Wiborg—2 pkgs. machinery, $1,130. Exports for the week ended Nov. 29: Antwerp—62 pkgs. material, $2,308; 5 pkgs. machinery, $130. British Possessions in Africa—31 pkgs. machinery, $1,100. British West Indies—1 pkg. machinery, $100. Bremen—1 pkg. material, $200. Brussels—35 pkgs. machinery, $2,000. British Guiana—14 pkgs. material, $400. Birkenhead—1 pkg. machinery, $75. British East Indies—31 pkgs. material, $4,069. Berlin—5 pkgs. material, $1,080; 1 pkg. machinery, $68. Chili—6 pkgs. material, $408. Central America—170 pkgs. material, $1,662; 31 pkgs. machinery, $722. China—1 pkg. machinery, $58; 1 pkg. material, $20. Copenhagen—46 pkgs. machinery, $3,650. Cuba—81 pkgs. material, $2,202. Ecuador—8 pkgs. material, $172; 1 pkg. machinery, $65. Glasgow—3 pkgs. material, $115; 63 pkgs. machinery, $7,890. Genoa—21 pkgs. material, $750. Havre—1 pkg. machinery, $75; 7 pkgs. material, $269. Hong Kong—6 pkgs. machinery, $225. Hamburg—10 pkgs. material, $270. Japan—46 pkgs. material, $13,292; 25 pkgs. machinery, $5,979. Kirkcaldy—6 pkgs. machinery, $1,175. Liverpool—318 pkgs. material, $25,367. London—78 pkgs. material, $5,826. Madrid—1 pkg. machinery, $42. Manchester—235 pkgs. machinery, $28,123; 16 pkgs. material, $1,423. Mexico—97 pkgs. material, $2,321; 41 pkgs. machinery, $2,767. Naples—6 pkgs. material, $250. Newfoundland—7 pkgs. material, $262. Odessa—3 pkgs. machinery, $1,000. Philippine Islands—17 pkgs. material, $1,418. Peru—21 pkgs. material, $808. Stockholm—1 pkg. material, $10; 1 pkg. machinery, $34. Southampton—28 pkgs. material, $948 Siam—75 pkgs. material, $5,010. St. Petersburg—1 pkg. machinery, $400. U. S. Colombia—8 pkgs. material, $185. Venezuela—26 pkgs. material, $156.

THE SPRAGUE ELECTRIC COMPANY is receiving many orders for its direct-current apparatus, and reports among recent sales the following: Twenty 200-kw turbine generators, three 75-kw generators and four 20-kw generators to the De Laval Steam Turbine Company, Trenton, N. J.; one 200-kw belted type and one 200-kw engine type generator to H. O. Wilbur, Philadelphia; one 200-kw engine-type generator to the Otis Elevator Company, Yonkers; one 200-kw belted-type generator to W. D. Ewart, Chicago; one 40-kw and two 35-kw belted-type generators to the Criterion Hotel, New York; one 75-kw belted type generator to C. Poyet, New York; one 50-kw belted-type generator to the American Express Company, Chicago; two 3-hp round-type motors to the West End Theatre, New York; eight 8-kw generators, six 5-hp and four 1-hp motors to the Fischer Motor Vehicle Co., Hoboken, N. J.; one 40-hp medium-speed motor to J. F. Perkins Company, Brooklyn; one 16-hp motor to L. W. Pond Machinery & Foundry Company, Worcester, Mass.; one 40-hp belted-type motor to Miehle Printing Press Manufacturing Company, Chicago; two 20-hp motors to the Sigourney Tool Company, Hartford, Conn.; one 17-hp motor to the Martinique Apartment House, New York; two electric hoists to the Phœnix Iron Works, Phœnixville, Pa.; one electric hoist to Landis Tool Company, Geiser Station, Pa.; one electric hoist to the American Car & Foundry Company, Berwick, Pa.; one electric hoist to Scranton Supply & Machinery Company, Scranton, Pa., and one electric hoist to Pond Machinery & Tool Company, Plainfield, N. J.; two electric hoists to Michigan Alkali Company, Wyandotte, Mich.

THE MONTEREY, MEX., STREET RAILWAY COMPANY, which concern, as already noted in these columns, has been formed with American capital for the purpose of constructing and operating an electric traction system in the city of Monterey, Mexico, has purchased the Ferrocarriles Urbano de Monterey "Empresa Mexicana," which operated the principal horse tramways in Monterey. With the lines recently acquired, the American interests, who are represented by the banking house of Sperry, Jones & Company, of Baltimore, Md., have now control over 70 miles of road. The conversion to electric motive power will be proceeded with immediately and will mean an expenditure of at least $5,000,000. The Empresa road was purchased for $252,000. All the material and equipment will be purchased in the United States. A. W. McLimont, the chief engineer and general manager of the Monterey Street Railway Company, will arrive in New York Monday to place contracts. While here he will make his headquarters in the Washington Life Building, 141 Broadway. In the meantime a contract valued at about $10,000 for line construction work, tools, etc., has been awarded to the New York Hardware Company, of 54 Stone Street, New York. The Monterey system will be a double-track one.

IMPORTS OF MANUFACTURING MATERIAL.—The activity of the manufacturers of the United States, measured by the figures of imports of manufacturers' materials and exports of manufactured articles, is greater than ever before. Imports of manufacturers' materials in the ten months ending with October, 1902, are, as shown by the figures of the Treasury Bureau of Statistics, 365 million dollars, against 201 million dollars in the corresponding months of 1896, 274 millions in the corresponding months of 1899, and 319 millions in the corresponding months of 1901. The imports of manufacturers' materials in ten months of 1902, therefore, are 15 per cent. higher than those of 1901, the highest record heretofore, and more than 30 per cent. in excess of the figures for the corresponding months of 1896. On the other hand, exports of manufactures are also larger than those of any preceding ten months' period, with the single exception of 1900, showing an increase of 15 million dollars over the total for the ten months of 1901, and being actually more than double the figures for the corresponding months in 1895.

INSTRUMENTS FOR JAPANESE NAVY, ETC.—Foote, Pierson & Company, of 82-84 Fulton Street, New York, have secured a contract from the Japanese Government for special electrical instruments for the navy department. An order has also been received from the same government for recording instruments, to be used in connection with wireless telegraphy. The United States Government has allotted a contract to the Fulton Street concern for electrical tidewatre indicating devices for automatically recording the range of the tide at various coast fortifications. Substantial orders are also to hand for Argus lightning arresters for use in connection with aerial underground and submarine cables.

MEXICAN LIGHTING PLANT TO BE ENLARGED.—The Postosina Electric Company, of San Luis, Mexico, which was formerly known as the San Luis Potosi Electric Company, is about to award contracts for the enlargement of its plant, which is at present equipped with a 500-kw alternating-current generator, belted to a 750-hp engine, both built by the Westinghouse interests. The additions will involve the installation of a 1,000-kw equipment. Sanderson & Porter, 31 Nassau Street, New York, have been retained as consulting engineers by the Mexican company.

OCTOBER EXPORTS show a decided tendency toward recovery from the depression, due largely to the short corn crop of last year and reduced foreign demand for other breadstuffs. The total exports for October were larger than those of any preceding month in the history of our commerce, except October and December, 1900, and October, 1901. The following shows the October exports in each year, from 1895 to 1902: 1895, $87,090,972; 1896, $113,516,586; 1897, $111,744,517; 1898, $118,619,563; 1899, $125,966,527; 1900, $163,389,680; 1901, $145,659,415; 1902, $143,179,752.

THE DE LAVAL STEAM TURBINE.—Curtiss-Crippen Engineering Company has opened an office in 1232 Monadnock Block, Chicago, in charge of L. F. Mahler, who was formerly a constructing engineer for the De Laval steam turbine in Europe. Mr. Mahler also represents the allied company, the New York Electric Headlight & Train Lighting Company, which uses the De Laval turbines for train lighting and electric locomotive headlights. The Pennsylvania company now has one train of the limited service equipped with a turbine driven lighting unit.

ESCHER, WYSS & CO., of Zurich, Switzerland, have been awarded a contract to build three new turbines for the Canadian Niagara Power Company. Each wheel will be of 10,000-hp capacity, and it is understood will be of similar pattern to the wheels installed by the Niagara Falls Power Company in wheel-pit No. 2, which are of the Francis or inward discharge type. The new turbines are to be delivered the latter part of next year.

MOTORS, ETC., FOR MEXICAN TRANSMISSION PLANT.—Rossiter, MacGovern & Company, 141 Broadway, is about to let contracts for motors, etc., to be used in connection with the Toluca, Mexico, power transmission scheme.

THE MEXICAN TRAMWAYS COMPANY, LTD., of the City of Mexico, contemplate still another extension. It is now proposed to extend the lines to Texcoco, which will mean the construction of nearly 20 miles of track.

General News.

THE TELEPHONE.

BIRMINGHAM, ALA.—The People's Home Telephone Company has petitioned for the right to increase its rates.

MENA, ARK.—The Kizer Telephone Company has been incorporated with a capital stock of $50,000. It proposes to build and operate telephone lines in the counties of Miller, Little River, Sevier, Howard and Polk. A. J. Kizer is president.

ATLANTA, GA.—The Southern Bell Telephone Company has begun work on a $35,000-annex. Accommodations will be provided for 10,000 telephones.

WAYNESBORO, GA.—The Augusta Telephone and Electric Company will install a new Strowger telephone exchange in Waynesboro, starting with about 100 telephones.

BOISE, IDAHO.—The Independent Telephone Company announced that the New Placerville line is in service. This gives two independent company lines to Placerville.

LEWISTON, IDAHO.—The work of surveying for the new telephone line down Snake River, from the Imnaha to Lewiston, has been given to McCullough & Doughty.

EVANSVILLE, IND.—The franchise of the Cumberland Telephone Company in this city having expired and the company given official notice three months ago to vacate the streets and alleys, it now comes forward and proposes that the question of a new franchise be submitted to a board of three members and on its decision a new lease be written.

BONEPARTE, IA.—The Union Telephone Company is extending its line from this city to Harrisburg township.

SLOAN, IA.—The Sloan Telephone Company has been organized here with a capital stock of $3,000. W. D. Buckley is president.

WATERLOO, IA.—Representatives of sixteen independent telephone companies met here recently and formed the Northeastern Iowa Independent Telephone Association. The object of the association is to secure better connections and to regulate the toll rates for the different lines.

DES MOINES, IA.—The Hawkeye Telephone Company is stringing 800 miles of copper wire from this city to surrounding towns on four different routes. Of this line, 400 miles is to be used by the Hawkeye Company. The other 400 miles will be leased by the Weare Commission Company. The latter will be independent service, serving offices which the Weare Company will open in twenty-four towns surrounding Des Moines.

FRANKFORT, KY.—The Owenton Telephone Company has been incorporated; capital, $7,500. J. W. Counvach, J. Gayle and J. A. Johnson are the incorporators.

HOPKINSVILLE, KY.—The Cumberland Telephone Company has let the contract for a new exchange and office building at this place which will cost about $15,000.

COLDWATER, MICH.—The Himebaugh Telephone line will be extended to Coldwater.

GRAND RAPIDS, MICH.—The Citizens' Telephone Company has increased its capital stock to $2,000,000.

SAGINAW, MICH.—The Valley Telephone Company, of Saginaw, Flint and Bay City, has completed a contract with the Alma Telephone Company to construct a line from Flint to Holly and to connect there with the Alma Company. At the same time it will connect with the Oakland Telephone Company, and by that means Oakland County will have independent connection with the northern part of the State.

JACKSON, MICH.—The Jackson plant of the Citizens' Telephone Company has been placed in operation with 1,000 subscribers connected up. The board has a capacity for 1,600 lines. The plant originally belonged to the Federal Telephone Company, of Cleveland, and that company still maintains a heavy interest in it, although the control was sold some time ago the Citizens' Telephone Company, of Grand Rapids.

MINNEAPOLIS, MINN.—The Twin City Telephone Comapny has opened its new building at Cedar and Eighth streets, St. Paul. Thousands of people were shown through the building, every department of which was open to the public in the afternoon and evening.

WATER VALLEY, MISS.—The Cumberland Telephone Company is establishing a local exchange. Long-distance connections have been made.

HELENA, MONT.—Dr. Emil Dorn, of Chicago, has applied for a franchise for the construction and operation of a telephone system in Helena.

OMAHA, NEB.—The Nebraska Telephone Company has been granted a franchise in this place.

FAIRMONT, NEB.—A franchise has been granted to John Barsby, of this city, and C. H. Brown, of Grinnell, Ia., to construct and operate an independent telephone system here.

OGALLALA, NEB.—The stockholders of the Ogallala & Keystone Telephone company have elected the following officers: President, Hugh Carnahan; treasurer, Malcolm MacLean; secretary, W. A. Barnard; board of directors, J. J. McCarthy, W. Davison, M. MacLean and H. Carnahan.

MIDDLETOWN, N. Y.—The Farmers' Union Telephone Company, of Sussex, N. J., has completed its line to Johnsons. From there the line will be built to this city by the way of Slate Hill.

TROY, N. Y.—The Commercial Union Telephone Company has been incorporated here for the purpose of effecting a consolidation of the independent telephone lines throughout the State, and subsequently to instal telephone systems in cities and towns in which no independent lines now exist. The ramifications of the new company's lines will extend as far west as Buffalo, as far north as Montreal, and as far east as Rutland, Vt. The new company will operate in the cities and villages of Renssalaer, Saratoga, Washington, Warren and Essex counties, and in cities and villages of adjoining States. The capital stock is $10,000, and the directors for the first year are: John T. Christie, William C. Geer, Cornelius V. Collins, William Connors, Stephen C. Medbery, Peter McCarthy, William D. Mahony, James H. Cladwell and W. L. Burk. All of these are Troy men, except Mr. Medbery, whose residence is given as Ballston, and Mr. Burk, who is a resident of Glens Falls.

WILMINGTON, N. C.—Work of placing the local telephone wires of the Bell Company underground has been commenced.

ASHEVILLE, N. C.—The Asheville Independent Telephone Company proposes to build a new telephone exchange in Hendersonville, N. C., and the material has been ordered. It is said that the Bell Company had intended to put in exchange if sufficient encouragement was offered.

CRAYTON, OHIO.—A new telephone exchange is being installed at this place.

PORTSMOUTH, OHIO.—The Portsmouth Home Telephone Company will build a line from Fullerton up Tygart Valley to Tygart.

TIPPECANOE CITY, OHIO.—The Tipp Interurban Telephone Company is installing a new board and a number of new telephones. John I. Young is manager.

REPUBLIC, OHIO.—Citizens of this town have organized a company and contemplate installing a Globe automatic exchange. J. T. Carbin is in charge of the work.

SANDUSKY, OHIO.—It is stated that the deal whereby the Sandusky Home Telephone Company was to have been absorbed by the Local Telephone Company, of Norwalk, has fallen through. It is understood that the Sandusky people held out for $50 per share of par value for the stock, whereas the best the Norwalk people would give was $40. The Sandusky Company is in a very prosperous condition and the local people are well satisfied to keep their property.

MASSILLON, OHIO.—Stockholders of the Massillon Telephone Company have elected the following directors: O. C. Volkmer, H. A. Croxton, J. C. Putnam, J. B. Hoge, J. H. Hunt, F. S. Dickson, Maxime Reber, R. W. Judd and W. S. Cory. The company is controlled by the Federal Telephone Company, of Cleveland, and the majority of the directors are identified with the latter company. It was decided at the meeting to spend $10,000 for new cables and enlarging the switchboard.

PORTLAND, ORE.—The Boston Telephone Selector Company, capital stock $500,000, has been incorporated. J. F. Fanning is president.

HANOVER, PA.—Extensive improvements are being made on the telephone system of the United Telephone & Telegraph Company.

CHARLESTON, S. C.—The city has granted the Southern Bell Company the privilege of placing its wires underground.

COLUMBIA, S. C.—In view of the comment caused by the rapid absorption of independent telephone exchanges by the Bell Company the statement is made that the State legislature holds the power to revoke, amend, or modify the charter of the Bell Company in South Carolina at pleasure.

MARION, S. D.—J. A. Steninger, of Parker, has for the second time been granted a franchise to establish a local telephone system at this place. The original franchise granted him was defeated as the result of a referendum election called by local capitalists who believed the franchise should have been granted to home men. This objection was waived.

CLARKSVILLE, TENN.—The Home Telephone Company will erect an exchange building in this place.

TERRELL, TEX.—A telephone franchise has been granted to C. T. McCreary, of St. Louis; R. W. Wortham, of Paris, and T. R. Bond, of this city.

NEWPORT NEWS, VA.—The Bell Telephone Company, which recently purchased the independent telephone system in Hampton, will expend $20,000 remodeling the system.

RICHMOND, VA.—A bill has been introduced in the State Senate to give telegraph companies the right to build along the routes of railroads without having to acquire the consent of the railroad company.

PARADISE, W. VA.—The Paradise & Bigman Telephone Company has just been organized, and will build a line between the two places named.

HIGHLAND, WIS.—A new telephone line is being built from Montfort to this place.

MILWAUKEE, WIS.—The Wisconsin Telephone Company will erect a telephone exchange on Fourth Street to cost $12,000.

JEFFERSON, WIS.—Application has been made by Frank P. Mansfield, of Lake Mills, for permission to construct and operate a telephone exchange in this city.

KENOSHA, WIS.—Articles of incorporation for the Citizen's Telephone Company, Kenosha, have been filed with the Secretary of State. The incorporators are G. A. Yule, C. C. Brown, John B. Sloter, N. J. Corcoran, H. B. Robinson and J. Cavenaugh. The capital of the company is placed at $50,000.

KENOSHA, WIS.—Kenosha is in the throes of a telephone war, and two companies are now in the city seeking a franchise to build an independent system. At the last meeting of the common council C. A. Sterling, of La Crosse, asked for a franchise, and J. A. Keelyn, of Chicago, is seeking a right to establish in the city "a model system."

BUFFALO, WYO.—The Powder River Telephone Company, with Buffalo as its headquarters, was incorporated in 1891, with a capital stock of $10,000. The system has rapidly and steadily grown until now it counts 275 miles of lines with 13 stations telegraphically recognized by the Western Union. The system is now extended across the Big Horn range to Ten Sleep in the Big Horn Basin, where it connects with the Bell system, thus giving Buffalo telephone connection with every county in Wyoming except Wilson and Crook.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CALIF.—The Central California Electric Company's third electric power plant, which is in the Little Bear River Canyon near Alta, Placer County, Calif., recently went into operation. It is transmitting current 61 miles to Sacramento while the Newcastle plant is shut down for repairs to the canal. Within a short time the new plant, which includes two 1,000-kw Westinghouse revolving-field 3-phase generators direct-connected to Girard water wheels, will be transmitting electric power to Nevada City and Grass Valley. The pole line in this direction has been completed and sub-stations installed. The pipe line, which is 5,380 feet in length, is 38 inches in diameter for two-thirds of its length and 36 inches the remainder of the distance. Two additional generating sets, each of 1,000-kw capacity, will be installed, giving a total generating capacity of 8,000-hp. Current is generated at 500 volts, and six 375-kw transformers raise the line pressure to 16,000 volts. This will be increased to 32,000 volts as the load is increased. The water supply is obtained from the South Yuba Water Company's main Placer County ditch. The new system will compete with the Bay Counties Power Company in Nevada County. It is said that Eastern capitalists will buy both the water and the electric properties.

LEWISTON, IDAHO.—The Big Buffalo Mining Company whose properties are located at Buffalo Hump, this state, is about to install an electric power plant on its claims on Sheep Creek and will also put a large mill on its ground.

SPRINGFIELD, ILL.—The Lighting and Heating Company, of Kewanee, has been incorporated, with a capital of $50,000; incorporators, X. Caverno, B. C. Parkinson and James Nokes.

ODELL, ILL.—The Odell Electric Company has been incorporated with a capital stock of $5,100, by W. M. Buchanan, Anna K. Buchanan and William N. Buchanan, to supply electric light, heat and power.

VINCENNES, IND.—The Vincennes Electric Light and Power Company has been granted a twenty-five-year extension of its franchise.

MORGANTOWN, IND.—Morgantown is to have an electric light plant, the contract having been let to Charles Teeters. It is to be in operation by Jan. 1.

OSKALOOSA, IA.—The property of the Oskaloosa Light & Power Company has been conveyed to the Oskaloosa Traction & Light Company. The former is the old firm which existed in Oskaloosa before the advent of the Oskaloosa Traction & Light Company, which is an organization composed largely of Ottumwa capitalists. The property of the old company is in the hands of Samuel Mahon, of Ottumwa, as trustee.

JORDAN, MINN.—The Jordan Electric Light Company has been incorporated here. The city was unable to dispose of its bonds for electric light purposes and private citizens decided to organize a stock company. The company was given a ten-year franchise.

FARIBAULT, MINN.—The Minnesota Institute for Defectives has decided to install an electric ironing addition to its laundry, the present output of which is 30,000 pieces per week. Mr. A. R. Tracy, of this place, is engaged in putting in this up-to-date improvement, which consists of three dozen electric laundry irons including automatic regulators and several electric body and bosom ironing machines.

JERSEY CITY, N. J.—The Montgomery Light & Water Power Company has been incorporated here by Charles N. King, W. M. Grand and Samuel E. Renner. Capital, $2,000,000.

ALBANY, N. Y.—The North Hempstead Light & Power Company has increased its capital stock from $50,000 to $100,000.

TOLEDO, OHIO.—Alderman Usher has started a crusade to give Toledo a municipal lighting plant by introducing a measure providing that the matter of such a plant shall be submitted to popular vote at the next spring election.

MEDINA, OHIO.—The Medina Electric Light, Power & Heating Company has been incorporated to build a power and lighting plant at Medina. Incorporators: O. P. Van Sweringen, M. J. Van Sweringen, J. G. Boyd, S. C. Stewart and A. J. Watt. Capital stock, $50,000.

COLUMBUS, OHIO.—Director Immel, of the department of public improvements, announces that contracts for the proposed municipal lighting plant will be awarded in the very near future. The matter has been held up for some time. The plant will provide current for 1,500 arc lights and it will cost about $110,000.

LAWRENCEBURG, TENN.—The city council authorizes an election on December 16 to vote on a bond issue of $20,000 for water and lights.

NASHVILLE, TENN.—During the coming year the lighting facilities will be increased by the addition of 100 arc and 1,000 incandescent lights. The capacity of the lighting plant may be doubled later on.

NASHVILLE, TENN.—Chas. H. Fish, of Detroit, has purchased Caney Fork Falls, paying $100,000 therefor, and will erect an electric plant to furnish power to various Tennessee towns, including Nashville.

SWEETWATER, TEX.—A Mr. Williams has secured an electric light franchise in this place and has placed contracts for equipment.

SALT LAKE CITY, UTAH.—The Utah Sugar Company proposes to establish a power plant on the Bear River to cost about $150,000.

TACOMA, WASH.—The firm of Stone & Webster, which controls the street railways of Tacoma and Seattle, Wash., as well as the Interurban electric road connecting the two cities, is attempting to secure control of all of the electric railway power plants along the Sound, including the Bellingham Bay Improvement Company's plant in Fairhaven and its water-power electric plant now being constructed at Nooksack Falls. They have obtained control of the electric railway line between Fairhaven and Whatcom. They will soon acquire a title to the Tacoma Railway & Power Company for the sum of $700,000, as the injunction asked for by Wm. Collier, Jr., to restrain the officials from making the sale has been denied.

THE ELECTRIC RAILWAY.

QUINCY, ILL.—Contracts have been signed between a syndicate of Quincy capitalists and the firm of Bracey, Howard & Co., of Chicago, for the building of an interurban electric line from Quincy to Beardstown and from Quincy to Niota. The enterprise will require $3,000,000 for construction and equipment. The Rushville and Beardstown line is seventy miles long and the Niota is sixty miles. A line south through Pike and Calhoun counties to St. Louis will be built, it is said, immediately upon the completion of these lines.

VINCENNES, IND.—The Southern Indiana Traction Company—Vincennes-Jasper Line—has been granted a franchise in this city.

LOUISVILLE, KY.—Articles of incorporation have been filed by the Brownsboro Railway Company with a capital stock of $25,000. The incorporators are Emory D. Frazer and Mark Sands, of New York; L. G. Fisher and James H. Simpson, of New York; A. G. Turnipseed, of Cincinnati; J. Morton Morris and Clayton B. Blakey, of Louisville.

BOSTON, MASS.—The Secretary of State has issued a charter to the Greenfield, Deerfield & Northampton Street Railway Company Association. The directors of the company are J. B. Bridges, W. W. Sanderson, W. H. Belden, Oscar Belden, D. E. Cook, J. A. Taggart, E. C. Crosby, M. A. Coolidge, H. L. Williams, C. W. Wyman, F. E. Pierce, A. W. Clapp, D. P. Abercrombie, Jr., C. R. Graves and Philip Witherell. The capital of the company is $20,000.

BATTLE CREEK, MICH.—The Michigan Central Traction Company has applied for a franchise in Battle Creek.

KALAMAZOO, MICH.—The Michigan Traction Company is planning to spend $80,000 in improvements during the coming year. The company has placed an order for several new long cars.

MANKATO, MINN.—The City Council, of Mankato, where an electric city railway has long been talked of, has finally given a franchise to a Chicago company, which expects to build the line at once. This road, which will in all probability connect with St. Peter, Minn., will be the first rural electric railway in Minnesota, and no doubt will be the nucleus of many other rural urban lines.

JERSEY CITY, N. J.—The North Jersey Street Railway Company will build a new car barn at Montclair, N. J., at a cost of $100,000.

SYRACUSE, N. Y.—It is announced that the Auburn & Syracuse Electric Railway Company, now operating the street railway system in Auburn, has completed its financial plans for an interurban line between Auburn and Syracuse. The bonds have been purchased by N. W. Harris & Co., New York.

SCHENECTADY, N. Y.—The boycott on the Schenectady Street Railway Company's lines was lifted on November 26 by the Trades Assembly. It was explained that the boycott was taken off because the press of the entire country has raised such a howl over the expulsion of William Potter from the painters' union that public sentiment was turned against the boycott.

NEW YORK, N. Y.—Soundings are being taken in the Hunters' Point section of Long Island for what is expected to be the largest electrical power house in the world. The building is to be erected by the Pennsylvania Railway Company, and it is the reported intention to develop motive power to operate the entire underground system, which the company contemplates running under Manhattan, in addition to several of the shorter branches on the Long Island Railroad.

UTICA, N. Y.—The local trolley system was put out of business for five hours on the night of Nov. 18 as the result of a peculiar incident. A large blue heron alighted on a wire carrying power from the Trenton Falls station to one of the local sub-stations of the Utica and Mohawk Valley Railroad Company, and shortly thereafter the bird's bill came in contact with another wire. Immediately the current was short-circuited, the fuses at the sub-power-station burned out, the wires broke, the power stopped and the 22,000 volts that the wires carried wrought havoc with the bird. Scores of trolley cars on the city and suburban lines were stalled, and for five hours, or until the cause of the mischief was discovered and the damage repaired, all electric traffic in the Mohawk Valley was suspended. The trolley company sustained considerable loss as a result of the bird's prank.

NEW YORK, N. Y.—The Board of Estimate of New York met last week to consider the application of the New York City Interborough Railway Company for a franchise to operate street railways in the Borough of the Bronx. This company was formed as a rival to the Union Railway Company, which has become a part of the Metropolitan system. Everett P. Wheeler appeared as counsel for the New York City Interborough Company. He said that if the franchises were granted to his committee they would pay the city 15 per cent. on the gross receipts. He said the Union Railway Company was now paying 1 per cent. The company wanted the right to lay tracks on streets and also across Macomb's Dam Bridge. The new roads would erect thirty-six miles of trolley lines, of which twenty-four miles would be completed during the first year and the gross receipts from the first year would amount to $450,000. Wiliam H. Page, Jr., counsel for the Union Railway Company, spoke in opposition to the application. He said that the company should first apply to the State Railroad Commission.

YOUNGSTOWN, OHIO.—A syndicate represented by Max P. Goodwin, a Cleveland attorney, has secured nearly all the required right of way for an electric railway from Youngstown to Canfield.

COLUMBUS, OHIO.—The Central Market Street Railway Company has purchased land on Mound Street where it is proposed to erect two large car barns, a storage battery station and a rotary sub-station.

LIMA, OHIO.—The Lima Electric Railway & Light Company has about completed its new power plant which will supply current for both the lighting and street railway systems of the town. The plant has a capacity of about 1,500 horse-power.

IRONTON, OHIO.—Traction men from Columbus and Portsmouth are securing right of way to extend the Portsmouth Street Railway to Hanging Rock, where it will connect with the Camden Interstate Railway, forming a through line to Huntington, W. Va.

DELAWARE, OHIO.—The Delaware, Berkshire & Sunbury Electric Railway Company has issued bonds to the amount of $150,000 and filed a mortgage for the same amount to secure the bondholders. The company will build a line from Delaware to Sunbury.

COLUMBUS, OHIO.—The Urbana, Mechanicsburg and Columbus Electric Railway has closed a deal for the purchase of five acres of land in this city for terminal purposes. The Columbus power house of the company will be erected there, also the car barns and a freight depot.

FOSTORIA, OHIO.—The Toledo, Fostoria & Findlay Railway Company has disposed of a large block of bonds in New York and will start work as early as possible on its proposed extension from Fostoria into Toledo. The company owns private right of way the entire distance.

CINCINNATI, OHIO.—The Cincinnati Car Building Company will soon be organized by the Widener-Elkins syndicate. The Chester Park car shops of the Cincinnati Traction Company will be sub-leased and cars will be built for all the Widener-Elkins properties throughout the country.

YOUNGSTOWN, OHIO.—President Asa W. Jones, of the Youngstown & Southern Railroad Company, announces that the bonds of the company have been under written by a New York syndicate and that the road will be extended to East Liverpool instead of terminating at Columbiana as originally proposed.

CLEVELAND, OHIO.—Plans for the absorption by the Cleveland, Elyria & Western Railway, of the Cleveland & Southern Railway and the Norwalk Gas & Electric Company, have been worked out. The new company will have a capitalization of $5,000,000, of which $2,000,000 will be preferred and $3,000,000 common stock.

LANCASTER, OHIO.—The officials of the Scioto Valley Traction Company have practically completed negotiations for absorbing the Lancaster Traction Company, which operates a steam dummy line from Lancaster to the Boy's Industrial Home. It will be equipped with electricity and operated as a part of the Scioto Valley line.

TOLEDO, OHIO.—Work is to start at once for extending the Toledo & Monroe Railway from Monroe to Detroit. The company will use the overhead equipment now strung on the Detroit & Toledo Shore Line. Charles R. Hannan, of Council Bluffs, Ia., and Mathew Slush, of Mt. Clemens, Mich., have become interested in the Toledo & Monroe Company.

CLEVELAND, OHIO.—What is claimed to be the fastest long-distance run ever made by electric traction was recorded by a special car on the Lake Shore Electric Line on a trip from Cleveland to Toledo on Nov. 13. The car left this city at 3 A. M., arriving in Toledo, a distance of 120 miles, at 6.10 A. M., making the actual running time 3 hours and 10 minutes.

STEUBENVILLE, OHIO.—The Wellsburg, Steubenville & New Cumberland Street Railway Company has been incorporated under West Virginia charter with $10,000 capital stock. Incorporators: J. C. Mitchell, Henry M. Camp, of Rochester, Pa.; James E. Newell, East Liverpool, Wm. Freudenberger, of Steubenville, and Cyrus Ferguson, of McDonald, Pa.

CLEVELAND, OHIO.—The Cleveland, Akron & Southern Fast Line Railway Company has organized as follows: Judge C. R. Grant, president; C. A. Gates, vice-president; C. H. Wheeler, secretary-treasurer; T. L. Childs, general manager; George W. Sieber, general counsel. The company is negotiating for the purchase of the Cascade Mill and water power near Akron, for use in generating power for the road.

CINCINNATI, OHIO.—The Widener-Elkins syndicate, which has recently obtained control of the Cincinnati & Interurban Railway (Millcreek Valley), is planning to extend the line to meet an extension of the Indianapolis & Shelbyville Railway, also owned by the syndicate. The syndicate is planning lines in the direction of Chicago and the ultimate intention is to have a through line from Cincinnati to Chicago, by way of Indianapolis.

CINCINNATI, OHIO.—President G. R. Scrugham, of the Cincinnati & Eastern Railway, has announced that his company will introduce a novelty in the shape of moonlight excursions over the road between Cincinnati and New Richmond. The road runs along the Ohio River for a number of miles, affording a fine view of some of the most picturesque portions of the stream. On moonlight nights there will be no lights in the cars.

CINCINNATI, OHIO.—A merger of the Compton and Kroger traction interests in and around Cincinnati has been effected. The Cincinnati Milford & Goshen Traction Company promoted by W. C. Compton and the Cincinnati, Milford & Loveland Traction Company, headed by B. H. Korger, have been consolidated into a new corporation chartered as the Cincinnati, Milford, Loveland & Goshen Traction Company. The company is capitalized at $850,000 and both of the old interests will be represented in the directorate.

WAPAKONETA, OHIO.—The Sandusky Southwestern Electric Railway Company has elected officers as follows: George A. Hurd, Boston, president; S. W. McFarland, Wapakoneta, secretary; Samuel P. Douglass, Toledo, treasurer; F. O. Oleson, Wapakoneta, general manager; W. H. Hyke, Toledo, general superintendent, and I. E. Yarnell, Toledo, solicitor. The above with L. N. Means, Wapakoneta, and John Van Fleet and William P. Heston, Toledo, are directors.

CLEVELAND, OHIO.—The "community of interests" between the Widener-Elkins syndicate and the Pomeroy-Mandelbaum syndicate for control of lines in the vicinity of Cincinnati has been consummated and W. Kelsey Schoepf, president of the Cincinnati Traction Company has been elected to the directorate of the Cincinnati, Dayton & Toledo Traction Company (Southern Ohio). He will also bear the new title of chairman of the board. It is also understood that the Pomeroy-Mandelbaum people have secured large holdings in the Cincinnati Traction Company, but the amount is not given.

CLEVELAND, OHIO.—Frank L. Krause, chief promotor of the Pennsylvania & Ohio Traction Company, which proposes to build a road from Cleveland to Sharon, states that work on the line will start early in the spring. The road will be almost entirely on private right of way. The running time from Cleveland to Sharon will be two hours. It is stated that a private right of way has been secured into the center of Sharon which will save much time. It is announced that the road will be capitalized at $2,500,000, and that arrangements have been made to sell the bonds in Cleveland and Detroit.

GUTHRIE, OKLA.—The Guthrie Light and Traction Company, of Guthrie, has been incorporated for twenty years with $500,000 capital, to construct an electric railway system in Guthrie. The incorporators are John Shartel, of Oklahoma City, F. H. Greer, C. M. Barnes, H. H. Hagan and W. H. Mertens, of Guthrie.

OKLAHOMA CITY, OKLA.—The Oklahoma Traction Company, of Oklahoma City, has been chartered for 20 years, with $2,000,000 capital, to construct and operate a railway from Guthrie via Oklahoma City to Fort Reno, seventy-five miles. The incorporators are John Shartel, Selwyn Douglas, M. L. Spitlock, of Oklahoma City, U. C. Guss and George Green, of Guthrie.

PITTSBURG, PA.—A building permit has been issued in Allegheny to the Pittsburg Railways Company for its new power house on Brunots Island, Allegheny. The structure is to cost $100,000.

PHILADELPHIA, PA.—The 6,000 and odd motormen and conductors of the Philadelphia Rapid Transit Company have had their wages increased one cent an hour. The increase will cost the company about $275,000 additional expenditure annually. This advance is designed in effect to put the employees on the same wage-earning basis that the 10 per cent increase has accomplished for the Pennsylvania Railroad employees.

SUMMERVILLE, S. C.—It is said that all preliminaries have been completed for constructing an electric railway to Charleston. Negotiations for issuing bonds are now pending. Ohio capital is backing the undertaking.

AUSTIN, TEX.—The charter of the Metropolitan Street Railway Company, of Dallas, with a capital stock of $4,500,000, has been filed. The company has all the electric railway lines at Dallas, and will build interurban lines between that city and adjacent towns. All the directors are Dallas men with the exception of Guy E. Tripp, of Boston.

EL PASO, TEX.—The street railway system is tied up by a strike of all its operatives who went out on Nov. 19. The men asked for an advance of 10 cents an hour and for the reinstatement of a discharged man. They were earning 15 cents an hour. The management declined to treat with the union and the cars were run into the barns and abandoned.

SALT LAKE CITY, UTAH.—A franchise has been granted to the Consolidated Railway & Power Company to extend its lines to several of the smelters in this locality, also on several streets of the city.

WASHTUCNA, WASH.—Colonel Lunceford and P. R. Clark, of Ritzville, have petitioned the Adams County board of commissioners for a franchise for the construction of electric railway and for the transmission of electric power along the public roads of this county.

NEW INDUSTRIAL COMPANIES.

THE AMERICAN DRY BATTERY COMPANY, of New York, has been incorporated with a capital of $2,000. Directors: J. R. Colburn, L. A. Merrill and F. J. Byrne, New York.

THE WILKINSON-RICHARDSON COMPANY has been organized at Middletown, N. Y., to manufacture electrical supplies. The capital is $15,000 and the directors are J. W. Richardson, C. B. Hulse and T. C. Rogers, of Middletown.

THE CINCINNATI EQUIPMENT COMPANY has been incorporated with $15,000 capital by A. W. Goldsmith, Emil Jacobson, H. Henke, Eugene Brunsman and Frank Fromhold. The company will rehabilitate locomotives, cars, and street cars.

THE TEXAS TELEPHONE MANUFACTURING COMPANY has been organized at Austin, Tex., for the purpose of manufacturing switchboards and electrical specialties. The capital stock is $10,000. O. L. Brailey is president and treasurer, A. E. Jeavons vice-president and general manager, and H. Snelling secretary.

LEGAL.

TRANSFER OF UNISSUED PATENTS BY ORAL AGREEMENT.—Judge Baker, of the United States Circuit Court for the District of Indiana, has rendered an important opinion in a case involving a contention as to the validity of an agreement granting an exclusive right to manufacture under a patent when such agreement is an oral one and granted prior to the issue of the patent. The plaintiff, Frank B. Cook, contended, in the words of the opinion, "that an oral agreement for the sale of an invention made after application for a patent and before it is granted, is invalid both at law and in equity when pleaded as a bar or defense to a bill by the patentee for infringment." The court held that an oral agreement for the sale of an invention, founded on a sufficient consideration, made pending an application for a patent, is valid in equity. That while the inventor's exclusive right to an improvement commences only with the issue of a patent, he is vested by law with an inchoate right to its exclusive use which he may perfect and make absolute by proceeding in the manner which the law requires. That Cook possessed this unchoate right at the time the oral agreement was made with the defendants, the Sterling Electric Company, the invention then having been made and an application for the patent pending. Cases are quoted which the court states establish the doctrine that an oral agreement for the sale and assignment of the inchoate right to exclusive use of an invention before a patent has been granted therefor,

is not within the statute of frauds, nor within Section 4898 of the Revised Statutes, requiring the assignment of a patent or of an interest therein to be in writing; and that such an agreement may be specifically enforced in equity upon sufficient proof thereof. As to the contention that whatever may be of the defendants under the agreement, the legal title is in the complainant and that the oral agreement cannot be set up as a defense, and that the defendants should file a bill setting up their equitable rights and compel a transfer of the legal title, the court said this contention overlooks the fact that this is a suit in a court of equity where, in matters within its jurisdiction, an equitable title is as good as a legal title as to all parties affected by such equity. It cannot be maintained in a court of equity that a party holding the equitable title will be denied his equitable rights by the holder of the naked legal title. In such a case the holder of the legal title stands, in a court of equity, as a mere trustee for the use and benefit of the owner of the equitable title or estate. It certainly would be against conscience to permit a complainant, while holding the consideration for the oral agreement of sale, to pursue the defendants as wrong-doers.

OBITUARY.

G. H. CROSBY.—A special dispatch from Waterville, Me., dated November 25, says: Mr. George H. Crosby, of Albion, the inventor of the Crosby steam gauge, died at his home last Saturday night. He was 70 years old. He went to Boston when a young man and engaged as a machinist, and while in that city brought out the steam gauge that bears his name. He became wealthy through the invention. A widow and three children survive him.

PERSONAL.

MR. W. STEWART has been appointed electrical superintendent of the Adams Gas Co., of Adams, Mass.

MR. F. A. LA ROCHE sailed on the Celtic on Wednesday last for a two-months' trip to England and France.

MR. F. J. LAMB, of Grand Rapids, Mich., has sold out the electrical business of Lamb & Co. to Mr. John Ruthven.

MR. HENRY G. FOREMAN has been elected chairman of the Chicago Union Traction Company, succeeding Mr. Jesse Spaulding.

MR. FRANK J. SPRAGUE, who has been in Europe for some time past for recreation and to look over the electric railway field, is expected home early this month.

MR. F. S. DICKSON, the new president of the Federal and the Cuyahoga Telephone companies, of Cleveland, has decided to make Cleveland his permanent headquarters.

MR. CORNELIUS VANDERBILT has written an able and interesting article in the December *North American Review* on electricity as a motive power for trunk railroads.

MR. C. T. YERKES.—The passenger list of the Hamburg-American steamer Deutschland, from Southampton, December 1, contains the names of Mr. Charles T. and Mrs. Yerkes.

MR. AUGUST BELMONT, president of the Interborough Rapid Transit Company, is to become president, it is stated, of the newly acquired Manhattan Elevated Railway Company.

MR. J. BEYERS HOLBROOK, M. E., has been admitted to partnership in the engineering firm of Charles Henry Davis & Partners, as the heating and ventilating engineer of the concern.

MR. CHARLES A. TREMERE, formerly president of the Florida Electric Company, of Jacksonville, Fla., is no longer connected with that corporation, having sold out his interest to Mr. T. W. Dunk, of that city.

MR. ANDREW CARNEGIE, who has been ill in London for the past few weeks, on account of eating bad food in a Swiss hotel, is reported able to sit up and much better. He was, according to a London dispatch, to sail for New York on Wednesday of this week.

MR. F. A. PICKERNELL, electrical engineer for the American Telephone & Telegraph Company, in New York, is removing to Boston, where, it is understood, the "long-distance" engineering work will be concentrated. He and his associates will be greatly missed.

MR. E. R. KNOWLES, C. E., E. E., of New York City, has been retained as consulting electrical engineer for the St. Lawrence Power Company, and has just returned from a trip of inspection of their large power plant at Massena, N. Y., recently illustrated in these pages.

MR. W. F. C. HASSON has been elected chairman of the Honolulu Engineering Association, this office corresponding to the usual one of president. Mr. Hasson is Government electrical inspector for the Territory of Hawaii, the duties of the office including both outdoor and indoor inspection.

MR. N. G. WILSON, of the British Westinghouse Electric & Manufacturing Company, Limited, is now on this side. Mr. Wilson has charge of the turbine engine department of the new Manchester plant of the British Company and is at present in Pittsburg studying such machinery in the Westinghouse works there.

MR. A. B. CHANDLER, the veteran telegrapher and well-known president of the Postal Telegraph Cable Co., was slightly burned this week while helping to extinguish a fire which broke out in his residence in Brooklyn and which did considerable damage. The fortunate thing is that Mr. Chandler escaped serious personal injury.

MR. WILLIAM J. CLARK, general manager of the foreign department of the General Electric Company and also one of the leading officials of the British Thomson-Houston Company, Limited, which is now controlled by the General Electric Company, is on a visit to the United States and making his headquarters at the offices of the General Electric Company in New York City.

MR. JOHN D. ROCKEFELLER, of the Standard Oil Company, is now the largest stockholder of the Manhattan Elevated Railway Company. He has, in round numbers, 100,000 shares of the stock which is 25,000 shares more than stands in the name of Mr. George Gould. Mr. Russell Sage, who has always been rated the largest stockholder next to Mr. Gould has reduced his holdings to 12,000 shares.

MR. Y. NOGAMI, chief engineer of the Tokio Electric Light Company, of Japan, whose plant is to be largely increased for the purpose of furnishing power to operate over 20 miles of new track of the Tokio Street Railway Company, is now in New York. While here he will secure data regarding equipment which is to be forwarded to Japan, where the letting of the contracts will be determined on. Mr. Nogami is a guest at the Empire Hotel.

MR. A. O. KUEHMSTED.—The friends of Mr. Armin Oscar Kuehmsted, president of the Gregory Electric Company, Chicago, are congratulating him upon his marriage, November 26th, to Miss Marie Chisolm Gregg, of Chicago. Mr. Kuehmsted is very well known and very popular with the electrical fraternity in the West, and every one wishes him a long and pleasant married life. Mr. and Mrs. Kuehmsted left Chicago immediately after the ceremony for a trip through Cuba, Florida, etc.

MR. RAMON VALDES, of 44 Bond Street, New York, who is primarily interested in the project of the Rio Plata Electric Company, which concern proposes to construct a hydraulic plant of 1,600-hp initial capacity in the Rio Plata mountains, Porto Rico, for the purpose of generating power to be conveyed to San Juan, 17 miles distant, and to build and operate an electric traction system between the towns of Catano and Bayemon, a distance of four and one-third miles, is now in Porto Rico regarding the matter.

MR. GEORGE WESTINGHOUSE is the theme of an interesting article in the London *Daily Mail* by Mr. F. A. McKenzie, who remarks: "How is it that one man, Mr. George Westinghouse, has built up in a generation, a business like this? For two days I have paced his factories striving to learn the secret. It may be told in a few words. Foresight, anticipation of the world's future needs, bold and costly experiments, trained technical skill, the abundant use of labor-saving appliances, and an elaborate system of organized intelligence."

MR. JOHN B. McDONALD, the builder of the New York Subway, is the subject of an appreciative illustrated article in the *World's Work* for December. When Mr. McDonald undertook the problem of the New York Subway and some one said "Difficult job!" he replied: "Difficult? Not a bit. It's cellar digging—just a lot of cellar digging. Put all the cellars in New York in a row and they'd make a tunnel from here to Philadelphia. There's nothing hard about digging a cellar, and a row of cellars isn't any harder. It takes longer—that's all."

MR. JAMES SWINBURNE, president of the English Institution of Electrical Engineers, is well known for his versatility and literary ability. Both are exemplified by a recent contribution to the *Westminster Review* on "Feminine Mind Worship." It is a highly ingenious plea for better educational ideals, alike for men and women, and insists that much of the training that women are now getting enables them to do feminine work previously monopolized by men. Electricity has been a most noteworthy ally of woman in shutting the sterner sex out of the softer jobs.

NEW YORK ELECTRICAL SOCIETY has elected the following new members: W. A. Belden, 8 Westchester Avenue, Bronx, New York; Thompson D. Harbinson, care Portland Cement Company, Stewartsville, N. J.; J. O. Sinkinson, 55 Duane Street, New York City; M. B. Foster, Fuller Building, Broadway and Twenty-third Street, New York City; Leon E. Schmielsewski, care Stanley & Patterson, 93 Liberty Street, New York City; W. C. Andrews, 114 Liberty Street, New York City; Charles R. Pratt, Marine Engine & Machine Company, Harrison, N. J.; Harold Melbin, 217 West Sixty-eighth Street, New York City; E. B. Conrad, 127 Humphreys Avenue, Bayonne, N. J., and A. Frederick Collins, 63 West Twelfth Street, New York City.

MR. H. D. CRITCHFIELD, for several years general counsel of the Federal Telephone Company, of Cleveland, has resigned to accept a position with the Automatic Telephone Company, of Chicago, which is putting in an independent telephone plant in Chicago. Mr. Critchfield has been very prominent in the independent telephone movement in Ohio and the central West, and is one of the best posted men on the subject in the country. He is president of the Ohio Independent Telephone Association, and is closely identified with Judge James M. Thomas, president of the Independent Telephone Association of America. Mr. Critchfield has been succeeded in his position with the Federal Company by Mr. L. Carey, assistant general counsel of the company for some time past.

MR. THOMAS M. MOORE, chief of the Department of Machinery Exhibits of the St. Louis Exposition, has received a cablegram from Lieutenant Godfrey L. Carden, one of his assistant chiefs, now at Berlin, Germany, stating that the steamer has sailed with the Durr boiler entered for the Exposition. This is the first foreign shipment made for the Fair. It is an 800-hp boiler, and Chief Moore says that it will be installed and in service in the Exposition power house in January next if the building is ready for it at that time. Mr. Moore expects to have several other boilers on the grounds in January, including one from Gummersbach, Germany; one from Kiel, and two from Brooklyn, N. Y. He will also have a 200-hp engine supplied by the Skinner Engine Company, of Erie, Pa., which is to drive a generator furnished by the Warren Electric Manufacturing Company, of Sandusky, O. These boilers, engines and generators are all entered as exhibits, and will be kept in operation from the time they are installed next January until the close of the Exposition two years hence.

MR. L. W. STANTON, who has been electrical engineer and superintendent of equipment for the Federal Telephone Company, of Cleveland, Ohio, has resigned his position with that company and opened offices in the same building (The Electric building) as consulting telephone engineer. Mr. Stanton's practical working experience with all classes of outside construction, and his acquaintance with all the latest forms of central energy equipment, together wi a thorough technical training, qualify him admirably for his new work, and will help to fill a much felt requirement in independent telephony. Mr.

Stanton has closed several contracts throughout the central West for making a systematic inspection of the plants, and drawing specifications for new equipment. The drawing of specifications for new equipment is especially valuable to the independent companies which are installing modern central energy systems. The experience which Mr. Stanton has gained through equipping, maintaining and operating the various plants of the Federal Telephone Company, will prove of great value to parties who are fortunate in securing his services.

MR. HENRY W. POPE, for the past three years acting general manager of the Bell Telephone Company, of Buffalo, comprising the seven counties around Rochester and Buffalo, has been assigned to the headquarters of the American Telephone and Telegraph Company in New York. Mr. Pope has been in charge of the Buffalo Company during its period of reconstruction, which has spread over the past three years and was finally completed Oct. 4th, by the opening of the new Lockport exchange and the new "North" exchange at Buffalo. During this time the subscribers have increased from some 8,000 to 22,000, Buffalo having 12,000 and Rochester 5,500. A dozen new or reconstructed exchanges have been built and new toll lines completed or greatly increased in capacity. Upon the departure of Mr. Pope from Buffalo he was the recipient of a beautiful loving cup and gold-headed cane from department officials and the clerical force of his office, presented at a banquet given him at the Iroquois Hotel. It may not be generally known that Mr. Pope is again on familiar ground, as he was one of the pioneer telephone managers in New York City

Trade Notes.

THE AUTOMATIC SWITCH COMPANY, recently organized at Waterbury, Conn., has established a factory at Oakville, where it will manufacture electric time switches.

"SIGNS OF THE TIMES."—This is the season for sign lamps, and lamps for decorations. The Electric Appliance Company, Chicago, recommends the Packard sign lamps, and is prepared to make quick shipments.

THE GORDON BATTERY COMPANY, New York, reports business as exceedingly good at present, and that it is working its plant to its full capacity. The Gordon cell is used more than ever before, the demand for it requiring the company to increase its facilities very frequently.

PAWLING & HARNISCHFEGER, of Milwaukee, Wis., have brought out a special bulletin illustrating and describing their standard I beam trolleys for shop equipment, etc., electric traveling cranes and traveling electric hoists. There appears to be a great and growing demand for such apparatus for handling material, and this brochure indicates its latest modifications.

THE COLEMAN MANUFACTURING COMPANY, New York, manufacturers of the Palm air-deflector for electric fans, has opened an office and showroom at 71 Cortlandt Street. This company has recently completed arrangements with some of the largest fan manufacturers in the country to furnish deflectors for their fan motors. It is also receiving many inquiries from supply dealers and the trade generally.

THE DAYTON FAN & MOTOR COMPANY, Dayton, Ohio, has made arrangements with the Diehl Manufacturing Company whereby it has obtained a perpetual license to manufacture fans which embody the principles covered by the Diehl-Bennett patents. This company has enjoyed a very rapid growth, and to-day is doing an extensive export business, the Dayton fan having met with favor all over the world. Its new catalogue containing cuts and descriptions of its 1903 types of fans will be ready for distribution about January 1.

THE EUREKA ELECTRIC COMPANY announces to its many friends and customers that in its headquarters in room 656, in the Auditorium, Chicago, will be found during the telephone convention next week the latest products manufactured by this well-known company. The exhibit will be in charge of Messrs. I. J. Kusel, H. J. Kusel, D. I. Canmann, H. Rosenow, C. W. Robbins, Paul Gardner and others. Handsome souvenirs will be given away. Its exhibit embodied special features of the latest and up-todate improvements in the products of telephone apparatus.

MR. WILLIAM ROCHE, 42 Vesey St., New York, manufacturer of the new standard dry battery, is about to increase his facilities to keep up with the constantly growing demands for these cells. Mr. Roche, on Nov. 7th, celebrated the fifth anniversary of his start in business by giving a dinner to commemorate the event to a select party of friends and associates in business. Well wishes were expressed on both sides. During the evening Mr. Roche presented each of those in attendance with a handsome little present as a token of the occasion.

SUN ELECTRIC MANUFACTURING COMPANY.—On Wednesday, December 10, 1902, will be sold, at public sale, on the premises at West Chester, Pa., the property of the Sun Electric Manufacturing Company, telephone manufacturers, including a three-story brick factory building, 40 by 100 feet, with brick boiler house attached 20 by 34 feet, and about one acre of land, on the line of the P., W. and B. R. R., and, with the same, one 40-hp Ames engine and one 60-hp Ames boiler; also one power elevator and two large fireproof vaults. Also a lot of valuable machinery, all in first-class condition, a quantity of telephone material, the "Sun" patents, office furniture, etc.

HARDINGE BROTHERS, 1036 Lincoln Avenue, Chicago, are not a new firm at all, but have added to their line of work which is the manufacturing of watch makers' tools, tapes, dies and special work such as gear cutting and watch making for which they have the best facilities, the entire "Cataract Precision Lathe" business purchased from A. W. Gump & Co., who succeeded the Cataract Tool and Optical Co. They have, it is claimed, the largest stock of wire or split chucks extant and have been very successful in their business which has been in existence for the past 13 years. They manufacture meter parts and such like where good work is the essential quality. The workmanship is done by experienced and practical mechanics. They will be glad to receive inquiries in regard to their specialties and new lines of work requiring precision.

THE FRINK SYSTEM OF LIGHTING show windows and store interiors by special reflectors continues to prove its value. Latest advices from the manufacturer, I. P. Frink, 551 Pearl St., New York, state that some of their more recent orders were from the following: Max Weil & Co., St. Louis, Mo.; Smith, Gray & Co., Brooklyn; Hecht's Stores, Baltimore; Segelbaum & Co., Braddock, Pa.; Parker, Bridget & Co., Washington, D. C.; J. Keller & Co., Kendallsville, Ind.; G. B. French Co., Portsmouth, N. H.; Goldsmith Bros., Easton, Pa.; Woodward & Lothrop, Washington, D. C.; Gerardi Mercantile Co., Trinidad, Colo.; L. Bamberger & Co., Newark, N. J.; N. Snellenburg & Co., Philadelphia, Pa. These firms added to many hundreds of others using Frink reflectors for window, show-case, and interior store lighting are the very best testimonials. Many of the names represent houses of national reputation; all are representative of their several localities; and whatever has the stamp of their approval may be safely adopted by progressive merchants everywhere. Booklet and full information to solve lighting problems will be sent upon request.

JOSEPH T. RYERSON & SON.—The sixtieth birthday of Joseph T. Ryerson & Son, of Chicago, is commemorated by a special anniversary issue of *Ryerson's Monthly Journal and Stock List*. Advantage is taken to present a number of exceedingly interesting features. Among these are some historical notes and views, which are well worthy of attention. The name of Ryerson has been associated with the iron and steel business in America since its inception. The corporation has lately erected and nearly completed large new warehouses and structural yards in Chicago. The building, of two stories, is 175 by 266 feet in dimensions, 60 feet high, and has an annex one story in height, 112 by 125 feet. Through the entire length of the main building and structural yards, 300 by 600 feet, a railroad track runs, which is connected directly with all lines. Over these tracks are two overhead electric cranes, one for each floor, which are served by trolleys running the entire width of the building. In this warehouse machinery has been installed comprising a heavy electrically controlled plate shear, a powerful cold saw for heavy structural shapes and a combined machine specialy built for shearing, punching or coping lighter beams, bars and angles.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOVEMBER 25, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

714,127. ELECTRICAL MEASURING INSTRUMENT; C. W. Atkinson, Cardiff, England. App. filed May 23, 1902. A float in a body of liquid rises and falls under the fluctuations of current in a coil surrounding it. The float and the liquid in which it rests have equal co-efficiencies of expansion under heat.

714,158. OIL GUARD FOR COMMUTATORS; W. F. Dawson, Schenectady, N. Y. App. filed April 23, 1902. An annular oil guard extends radially outward beyond the line of the commutator surface.

714,159. TOP-HOLE PLUG; Andrew Dickey, Buffalo, N. Y. App. filed Dec. 2, 1901. A plug for a vessel containing molten metal, such as aluminum, sawdust or paper pulp is molded into the shape of a plug, covered with clay and inserted in the top hole, where it becomes converted into carbon.

714,181. TRIPPING ELECTRIC SWITCHES OR CIRCUIT BREAKERS; J. D. Hilliard, Jr., Schenectady, N. Y. App. filed Nov. 13, 1901. An auxiliary source of tripping energy is dispensed with and a circuit provided for this purpose which is normally inactive, but supplied with actuating energy the instant occasion requires it and which must be furnished if the system itself is alive.

714,189. TRAVELING CONTACT FOR RAILWAY TELEPHONES, TELEGRAPHS, OR THE LIKE; A. D. Jones, Louisville, Ky. App. filed April 4, 1902. (See page 910.)

714,201. STORAGE BATTERY; S. Laszcynski, Berlin, Germany. App. filed Feb. 23, 1901. A negative electrode of nickel oxid and a positive electrode of spongy zinc in a solution of aluminates.

714,210. MOTOR REGULATION; R. T. Lozier, New York, N. Y. App. filed April 2, 1900. A motor generator connected with the line is first used to supply current to the main motor and after the speed of the latter has reached a desired value, the motor generator is cut out and the main motor connected direct to line.

714,226. COIL FOR ARC LAMPS; W. H. Northall, Elwood, Ind. App. filed May 1, 1902. The wire of the coil is insulated with asbestos and a tough long fibre to make it heat proof.

741,232. TRANSFORMER, INDUCTOR, ETC.; F. Pichler, Weiz, Austria-Hungary. App. filed Oct. 23, 1901. Heat-radiating plates are inserted between the turns of the coil, the plates being slotted to prevent eddy-currents.

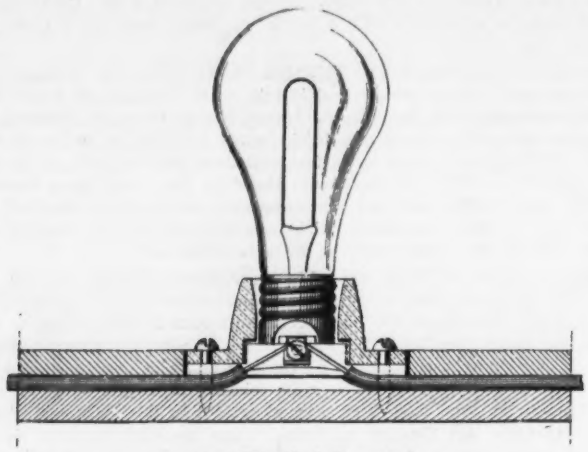
714,233. SIGN ILLUMINATED BY ELECTRIC CURRENT; E. Plancon, Lingevres, France. App. filed April 11, 1902. Geissler tubes in the form of letters are made by forming a groove in a glass plate, placing metal pieces in the groove and covering it with another plate.

714,246. WIRELESS TELEGRAPHY; H. Shoemaker, Philadelphia, Pa. App. filed Oct. 25, 1901. Instead of a coherer, a pair of plates are arranged in inductive relation and are caused to vibrate by the received currents and thereby control a local circuit.

714,267. TROLLEY POLE HARP; J. H. Walker, Lexington, Ky. App. filed Jan. 14, 1902. A harp of truss-like form between the members of which the wheel can be sprung into place. Other features are also designed.

714,268. CONTACT FOR TROLLEY HARPS; J. H. Walker, Lexington, Ky. App. filed Feb. 12, 1902. A modification of the preceding invention.

714,290. ELECTRICAL RECEPTACLE; P. H. Fielding, New York, N. Y. App. filed Jan. 18, 1902. A receptacle in which provision is made for the



714,290.—Electrical Receptacle.

wires in the molding to pass into and out of the bottom of the receptacle without cutting and without uncovering that portion of the groove in the molding directly beneath the contacts and binding screws.

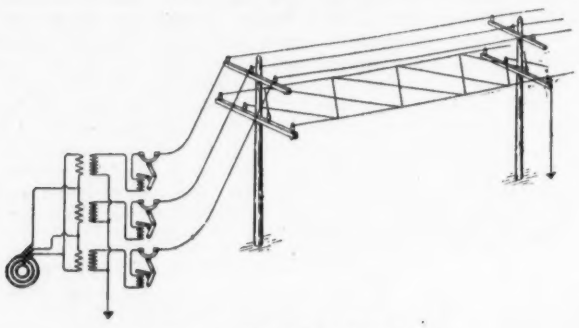
714,291. ELECTRICAL RECEPTACLE; P. H. Fielding, New York, N. Y. App. filed Feb. 20, 1902. A receptacle adapted for fuses in which the latter are housed in a groove formed in the base and covered by an elongated plug formed in the cap and adapted to enter the groove.

714,292. LAMP SOCKET; P. H. Fielding, New York, N. Y. App. filed Feb. 20, 1902. A weather-proof socket in which the case has no mechanical connection with the frame carrying the contacts and binding screws.

714,299. BUTTON FOR ELECTRAPHERS' KEYS, ETC.; H. J. Greule, Mason City, Iowa. App. filed March 4, 1902. The top of the key is dished and covered by a flexible diaphragm.

714,351. INDUCTION MOTOR STARTING DEVICE; A. H. Abell, Schenectady, N. Y. App. filed April 19, 1902. The object is to render it practically impossible to close the main-line switch until the resistance has been inserted in the secondary circuit and to prevent the resistance from being re-inserted while the motor is running without first opening the main-line switch.

714,355. PROTECTIVE SYSTEM; A. H. Armstrong, Schenectady, N. Y. App. filed March 30, 1901. A grounded network of wires is arranged



714,355.—Protective System.

under the main conductors to intercept the latter in case they fall and thus operate a cutout at the station before the conductors fall to the ground.

714,366. TRAIN SIGNAL SYSTEM; A. G. Davis, Schenectady, N. Y. App. filed March 10, 1902. A system in which the motorman cannot get the starting signal until notice is sent from each platform of the train where passengers enter.

714,373. ELECTRICAL DENTAL FURNACE; Ashley M. Hewett and John C. Muth, Chicago, Ill. App. filed Feb. 17, 1902. An inner muffle is wound with a resistance wire.

714,382. REGULATING DEVICE FOR DYNAMO ELECTRIC MACHINES; C. W. Kragh, Madison, Wis. App. filed Sept. 9, 1899. The regulating device is a coil on the field magnet of the machine arranged to act both as an opposition to the field energizing coil and as a resistance.

714,395. STARTING ROTARY CONVERTERS; W. B. Potter, Schenectady, N. Y. App. filed Sept. 7, 1899. An induction motor is used to drive a direct current generator for starting the rotary converters; in this way starting resistances and transformers are avoided.

714,400. ELECTROLYTIC CELL; M. C. Rypinski, Schenectady, N. Y. App. filed April 25, 1900. Rochelle salts in solution is used as the electrolyte.

714,436. HIGH POTENTIAL SWITCH; C. C. Badeau, Schenectady, N. Y. App. filed Feb. 20, 1901. A construction whereby the circuit is broken in the upper portion of the body of oil, where the oil is clearest.

714,446. PROTECTOR FOR THIRD RAILS OF ELECTRIC RAILWAYS; H. Brooks, Wheator, Ill. App. filed June 23, 1902. The protector consists of terra cotta tubing open to one side to admit the contact shoe.

714,452. POLARIZED ELECTROMAGNET; L. Cerebotani, Munich, Germany. App. filed April 25, 1902. A peculiar arrangement of horse shoe permanent magnets and electro magnets to increase the power and mechanical effect.

714,455. LIGHTNING ARRESTER; J. E. Cordovez, Panama, Colombia. App. filed April 19, 1902. Means for adjusting the tension of a spring-supported circuit closing armature.

714,497. RAILWAY ELECTRIC MOTOR COOLING SYSTEM; C. O. Mailloux and W. C. Gotschall, New York, N. Y. App. filed Aug. 26, 1902. A system wherein a cooling agent, such as compressed air or gas, is caused to circulate about the motor in accordance with temperature changes thereof by automatic means (See Current News and Notes.)

714,498. RAILWAY ELECTRIC MOTOR COOLING SYSTEM; C. O. Mailloux and W. C. Gotshall, New York, N. Y. App. filed Sept. 13, 1902. A modification of the preceding invention.

714,506. TROLLEY; J. Morgan, Ellwood City, Pa. App. filed Aug. 28, 1902. Details.

714,540. TELEPHONE SWITCH; J. A. Warrick, Sheldon, Ill. App. filed Nov. 5, 1901. (See page 910.)

714,577. TELEGRAPHIC OR TELAUTOGRAPHIC APPARATUS; E. K. Gruhn, Dresden, Germany. App. filed April 16, 1901. A ray of light is deflected by a mirror which is caused to change its angular position by the received currents.

714,587. MOTOR HANDLE FOR TOOLS; G. H. Hillyer, Duluth, Minn. App. filed April 29, 1902. A motor and gearing arranged inside of a tool handle.

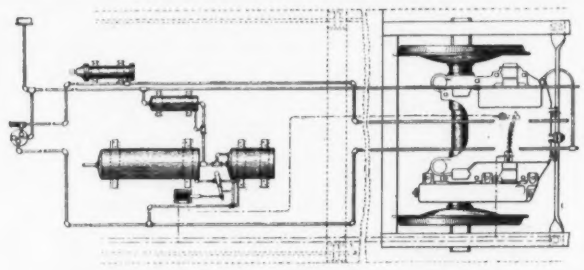
714,589. TROLLEY WHEEL; J. B. Lockerby, Ithaca, N. Y. App. filed Jan. 27, 1902. Details.

714,590. BATTERY DEPOLARIZER; C. E. Lockwood and W. C. Banks, New York, N. Y. App. filed Sept. 5, 1900. A depolarizer composed of a copper plating deposited upon the surfaces of finely divided iron particles and oxidized thereon.

714,593. ELECTRIC SWITCH; N. Marshall, Newton, Mass. App. filed Nov. 2, 1901. The clips have V-shaped bases which are set into V-shaped grooves in the insulating block and held by screws.

714,598. APPARATUS FOR SEPARATING METALS FROM SOLUTIONS CONTAINING SAME; Sidney Theodore Muffly, Bowdre, Ga. App. filed Jan. 22, 1902. A mattress cathode is composed of a cellular carbon plate and cellular porous carbon casings; a filiform packing of lead and zinc composition is within the casings and incloses the carbon plate, which, together with an iron plate anode, form electrodes connected to a source of electricity. All of the parts are enclosed in a fabric cover and there is an insulating frame between the plate anode and the mattress cathode, with means for supplying air to the bottom of the containing receptacle.

714,599. PROCESS OF PRECIPITATING METALS FROM SOLUTIONS CONTAINING SAME; Sidney Theodore Muffly, Bowdre, Ga. App. filed Jan. 22, 1902. The process consists in obtaining secondary or increased electrochemical action by passing a solution of requisite temperature com-



714,498.—Electric Railway Motor Cooling System.

bined with warm air to supply oxygen into and through a filiform and partly-soluble composition of lead and zinc inclosed in a porous cellular casing of carbon, together with a suitable plate-anode and comprising electrodes having connection with a source of electricity.

714,600. OUTLET BOX; E. W. Muller, Brooklyn, N. Y. App. filed March 12, 1902. A ceiling box having a central insulated hook for an arc lamp.

714,607. ELECTRIC CUT OUT; H. N. Potter, Pittsburg, Pa. App. filed March 27, 1901. A special angular relation of certain loose parts in a Nernst lamp to prevent vibration when the lamp is operated by high frequency currents.

714,608. TROLLEY GUARD; C. O. Prince, Canton, Ohio. App. filed Sept. 2, 1902. A cross bar below the wheel prevents the pole from rising should the wheel leave the wire.

714,630. APPARATUS FOR SIMULTANEOUSLY TRANSMITTING A NUMBER OF TELEGRAPHIC MESSAGES OVER A SINGLE WIRE; J. Zeigler, Vienna, Austria-Hungary. App. filed May 29, 1900. Relates to the construction of a commutating device.

714,648. WIRELESS TELEGRAPHY; H. Shoemaker, Philadelphia, Pa. App. filed May 13, 1901. A series of coherers provided with means for successively tapping the tubes to decohere the filings, such means being operated by a phonic wheel.